REPORT RESUMES

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SCIENCE INFORMATION PERSONNEL. THE NEW PROFESSION OF INFORMATION COMBINING SCIENCE, LIBRARIANSHIP AND FOREIGN LANGUAGE.

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THE REPORT DESCRIBES THE NATIONAL NEED FOR SCIENCE INFORMATION PERSONNEL AND THE RELATIVE IMPORTANCE OF FOREIGN LANGUAGE INSTRUCTION IN THE BACKGROUND PREPARATION FOR SCIENCE INFORMATION WORK. CHAPTER 1 DESCRIBES THE CREATION AND ORGANIZATION OF INFORMATION. CHAPTER 2 DEFINES THE OCCUPATION OF SCIENCE INFORMATION SPECIALIST. CHAPTER 3 DISCUSSES EXISTING PROBLEMS OF RECRUITING AND USING SCIENCE INFORMATION PERSONNEL FROM THE STANDPOINT OF MANAGEMENT AND THE SCIENTIST. CHAPTER 4 RECOMMENDS UNDERGRADUATE PROGRAMS FOR SCIENCE AND LANGUAGE MAJORS INTERESTED IN INFORMATION WORK. CHAPTER 5 RECOMMENDS GRADUATE PROGRAMS FOR THE SAME COURSE MAJORS. CHAPTER 6 DISCUSSES TRAINING. CHAPTER 7 OFFERS RECOMMENDATIONS AND PREDICTIONS FOR THE FUTURE OF SCIENCE INFORMATION WORK. (TC)

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SCIENCE INFORMATION PERSONNEL

The New Profession of Information Combining Science, Librarianship and Foreign Language

by

Leonard Cohan and Kenneth Craven

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Technical Information Project
Foreign Language Program
The Modern Language Association of America
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INTRODUCTION

Title VI, Part A, Section 602 of The National Defense Education Act of 1958 authorized the Commissioner of Education to determine, through contract, the need within the United States for increased instruction in modern foreign languages. The following report describes specifically the increasing need for modern foreign language instruction in the education of science information personnel; more significantly, however, the study measures (1.) the relative importance of foreign languages within a profession where language skill is only one qualification of employment and (2.) the national need for science information personnel. The table below indicates the priority ascribed to four professional backgrounds by science information officers in government, industry, and research organizations.

Relative Importance of Backgrounds in Science Information Work

	1st Priority	2nd Priority	3rd Priority	Unimportant	TOTALS
SCIENCE DISCIPLINE	256	45	5	-	306
LIBRARIANSHIP	113	104	22	19	258
FOREIGN LANGUAGE ABILITY	70	79	95	6	250
INFORMATION WORK	78	84	18	6	186
	517	312	140	31	1,000

The heading "1st Priority" includes requirements judged to be of primary and/or equal importance. Other headings are self-defining. A more detailed breakdown of these totals by government, industry, and research organizations will be found on page25 of the text.

Even at the outset, it was clear that the nature and degree of need for foreign language skill by science information personnel could not be studied divorced from the total educational and training requirements of that profession. Indeed, a lack of appreciation of the interaction of the three principal backgrounds of science, language, and information techniques (including librarianship) has, until now, seriously impeded the organizing of the profession.

Let us illustrate this interaction. In considering the information processes, it is often expedient to view a book, a journal, a statistic, a report, or a graph as an isolated quantum of recorded knowledge; however, there is a bond to the intellectual content that only a subject specialist can fully transcend; therefore, one can not divorce the study and practice of information work from the subject matter of a discipline. Furthermore, the habits of users compound subject matter problems. Just as the minds of chemist, engineer, artist, and linguist differ, so do the research and publication patterns of their disciplines, the nature and form of their available sources, and the relative importance in each subject of historical to current data. Yet knowing a subject is no assurance that a man will understand the principles and techniques of organizing its information. Conversely, to know the fundamentals of information processing does not make a librarian a science information specialist. There will always be a need for creators and processors of information who follow parallel paths toward the advancement of learning, but there is a new and insistent demand for a professional who understands the intellectual content of a subject, understands the principles and techniques governing the cycle of information, and has linguistic ability to operate effectively in both.

A national need for defining the profession and qualifications of information specialists arises because of the sheer mass of scientific information, its recondite sources, the growing need for retrospective searching of old literature and current awareness of what is new, and the dependence of scientific and technological progress on information resources and efficient information systems. All segments of society depend upon the future development of science information processes. The scientific researcher who depends on effectively controlled systems of information must also be highly trained and motivated to make full use of them; so with the engineer who requires speedy availability and conciseness of information sources; and so with the teacher of science and technology who must present his discipline in terms of mastery of its literature. Management too is realizing that survival requires support of information personnel and systems. Scientific and professional groups, journalists, and representatives of other media have an interest in informing the public of the nature of science information and advocating policies and programs to meet its personnel requirements.

Government officers have seen the critical significance of information activities in international scientific programs, and they comprehend its strategic value as a national resource for securing world peace. The creation of the Office of Science Information Service within the National Science Foundation (Title IX of the National Defense Education Act of 1958) indicates the critical importance of information processing in the scientific development of the nation. The cooperation of that agency throughout the contract year has contributed greatly to the success of this study. The proliferation of information facilities in industry and government and the assortment of new professional job titles (see pages 9 to 13 below) also bear witness to the development of the profession. In recognition of this growth, the Committee on Government Operations of the United States Senate issued in June 1960, "Documentation, Indexing, and Retrieval of Scientific Information - A Study of Federal and non-Federal Science Information Processing and Retrieval Programs" (86th Congress, 2d Session, Senate Document No. 113). In comparing the Senate Document with the draft of this report, one industrial officer noted that this report on Science Information Personnel "should serve as the much needed companion piece to the U.S. Senate's recent report, which -- though a fine review of current activities in the field -- was not able to go into the basic problems which have brought them about." The aim of this document, then, is to gain public understanding of the human problems and opportunities within this profession and professional acceptance for a needed program to recruit, educate, and train science information specialists.

Through correspondence, interviews, and a Symposium, the directors of the project have asked the advice of scientists, librarians, administrative officers, and educators within government, industry, and research organizations. See Appendix i for a list of contributors and Appendix ii for the membership of the Symposium. Based on their generous response, this report traces the educational, training, and recruiting needs of the profession and recommends a set of principles for acceptance or modification, but ultimately, for action.

Chapter I defines information and Chapter II, the profession; Chapter III discusses the present problems of recruiting and utilization of science information personnel from the standpoint of management and the scientist; Chapter IV recommends undergraduate and Chapter V, graduate programs for science and language majors interested in information work; Chapter VI discusses training, and Chapter VII offers recommendations and predictions for the future of science information work.

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v. Extract from the Proceedings of the Symposium on Technical Information Personnel, New York City, April 28-29, 1960, pp. 330ff. 95

vi. Extract from a paper of F. R. de Tonnancour, The Education, Training, and Recruiting of Technical Information Personnel 97

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I.

INFORMATION: CREATION AND ORGANIZATION

Information as substance is the basis for all intellectual activity. But information as accumulated substance is meaningless unless organized in the mind. The intellectual process includes creation, alteration, identification, recording, organization, storage, recall, conversion, synthesis, interpretation, translation, communication, and utilization. This processing of information is the basic task of the information specialist described below.

Since Aristotle, scholars in all disciplines have pondered the origins of knowledge, the problems of its organization, the rules of learning, and the relevance of knowledge to man's fate. Their findings have been set down and preserved by scribes, publishers, translators, archivists, and librarians. Until recently these information specialists have considered their function to be the accumulation and organization of knowledge as supporting creative work in the disciplines. But a sudden change has occurred, affecting both creators and processors of information. Information processing within the last fifteen years has reflected less man's quest for truth than his practical desire to survive. Today highly competitive organizations survive on the basis of the timely applicability of highly specialized scientific information often difficult to secure and difficult to analyze. These practical requirements have led to an eccentric development in information processing. Because of the universality of this revolution, facility with foreign languages has assumed new importance. This new pragmatic attitude toward knowledge suggests that it is no longer sufficient, even if it were possible, merely to furnish libraries that are organized, accessible, and complete. The scientific revolution has shattered the ideal that all pertinent and recorded information be available to all who need it in the most usable form, with the least distortion of subject content and in the shortest time. Repairing breakdowns in the information process and sorting technical and linguistic complexities require new productivity, new initiative, and new techniques.

With the possible exception of library science, prior efforts in information work have been fragmentary and parochial. What was lacking in these past endeavors was a unified, systematic approach to the entire cycle of information joining in a more effective liaison the creator, the processor, and the consumer of information. Although each discipline presents its own specialized and characteristic patterns of information processes, there is a defined cycle of information common to all. The information cycle has been subdivided into many individual and detailed processes, but it may, in general, be considered as: creation, publication, identification, recording, organization, storage, recall, conversion into more usable forms, synthesis, dissemination, interpretation, and utilization. Mathematical logicians, linguists, philosophers, computer scientists, librarians, intelligence experts, publishers, and documentalists have contributed to the new unified viewpoint. This integrated and unified approach to information is one deeply concerned with (1) an intense analysis of specialized subject content, and (2) the complex processing requirements of particular users.

II.

SCIENCE INFORMATION: A NEW PROFESSION

As a result of organized efforts by its practitioners, science information is gaining recognition as a branch of every scientific and engineering discipline. Yet today no distinct, organized profession of science information exists. But an increasingly large number of professional persons are engaging in science information activities exclusively. Their work is not yet a science or a rigidly-defined discipline or a learned profession with specific standards of education and performance. There is only a recognized area of study and activity whose parameters have not yet been fully defined.

The Elements of Work Basic to the Profession

A symposium was held in April, 1960, expressly for the purpose of developing information for this study. The distinguished panel of administrative officers, scientists, librarians, educators, and information specialists listed in Appendix ii agreed on seventeen recognizable elements of science information work. Twelve of these elements constitute the present tasks of science information specialists:

1. Administering
2. Locating materials
3. Selecting materials
4. Acquiring materials
5. Descriptive cataloguing
6. Subject analyzing including classifying, subject heading, and indexing
7. Abstracting and/or annotating
8. Performing reference work
9. Literature searching - bibliography
10. Transmitting and copying
11. Translating
12. Converting into machinable form

Another five elements represent recent and significant advances in the profession:

13. Developing of information systems
14. Investigating of machine applications
15. Information interpreting
16. Researching with information
17. Information scouting

Appendix iii defines these elements. The following frequency distribution indicates the identification of information elements in formal replies from 207 government, industry, and research organizations. Slighting of elements two, three, and four, particularly by industry, may be due to a tacit assumption that these elements are clearly information activities.

ELEMENTS OF SCIENCE INFORMATION WORK

Elements of Information Work	Technical Editing	1 Administering	2 Locating Materials	3 Selecting Materials	4 Acquiring Materials	5 Descriptive Cataloging	6 Subject Analyzing, etc.	7 Abstracting &/or Annotating	8 Performing Reference Work	9 Literature Searching—Bib.	10 Transmitting & Copying	11 Translating	12 Converting into Machinable Form	13 Developing of Information Systems	14 Investigating of Machine Applications	15 Information Interpreting	16 Research with Information	17 Information Scouting
Government	14	31	29	32	16	21	41	25	51	49	5	17	4	20	7	16	4	22
Industry	10	23	2	7	6	23	42	41	32	66	13	24	12	7	8	1	7	5
Research Organizations	1	10	7	7	5	13	18	14	23	25	4	11	9	5	1	2	1	4
ALL	25	54	38	46	27	57	101	80	106	140	22	52	25	32	16	19	12	31

Variables Influencing Development of the Profession

1. The varying scientific disciplines. A science concerned with millions of compounds, such as chemistry; one concerned with fundamental principles and their mathematical formulation, such as physics; and one concerned with principles applied to designs and graphic representations, such as civil engineering; all present differing information problems. The time factor in retrieval, the costs of experimentation, the publication patterns, and the logic of each discipline dictate unique approaches to its information processing. Inter-disciplinary research complicates the procedures. Much subjective data exists on the diversity of systems but little solid information or research is at hand on the value of various information systems.

2. The habits of users. A recent study at Case Institute of Technology showed that industrial chemists spend 32 percent of their working day and 51 percent of their total day searching for scientific information. How they search and how well they search are relevant questions. One researcher may scan hundreds of journals personally; his counterpart may prefer abstracts. An organic chemist may require a rapid search of a half-million compounds in order to find those he needs. An aeronautical engineer might call for a concise factual survey of the literature of a number of areas unfamiliar to him. Their information requirements depend on personal habits and idiosyncracies, prior education and training, earlier experiences with information systems and personnel, the type of investigation pursued (e.g. basic research, applied research, product development, state

of the art survey), the stage of a particular project, and the organization sponsoring it.

Whatever a scientist's habits, the information expert should be in the unique position of being able to offer new solutions to his needs, new sources of information, new approaches to utilization, and new services.

3. The sheer mass of accumulated data. The sheer quantity of research has outstripped the scientists' ability to search, survey and utilize the results. With the annual world-wide collection of scientific and technological publications totalling in the millions and doubling every eight and one-half years, researchers can no longer keep pace. As a result, forms and sources of these publications are constantly changing. Control of this vast literature, in its multiplicity of forms, is the objective of science information work.

4. The traditions of librarianship. Obviously, the elements of information work and librarianship overlap. Indeed, library schools have pioneered in this new profession which could not progress without the philosophy, experience, traditions, systems, and personnel of library science. But the full spectrum of science information processing is now more complex than librarians have been prepared, by education and training, to solve. Librarianship does not concentrate in depth on identification, conversion into different forms, synthesis, dissemination and interpretation of scientific information.

5. The influx of new personnel. Fortunately entering this new profession are scientists, engineers, linguists, and administrators with library school training or sophisticated experience in information processing, and new ideas. The meeting of minds among the traditional and the new professionals may lead to the fulfillment of librarianship. The unified approach to the information cycle provides the key.

As a result of this development, many logical, mathematical, and linguistic techniques have already been applied to problems of classification and systematic organization of knowledge. Indexing schemes continue to change. Electronic and mechanized devices have replaced manual methods for routine storage and retrieval. Specialists have introduced new techniques for the subject analysis of documents and for the integration and synthesis of several discrete units of information. Magnetic tape punched cards, electronic data processors, technical thesauri, random-access systems, and abstract bulletins reflect both new techniques and new personnel requirements.

The following list of job titles within government, industry, and research organizations gives some idea of the breadth and overlap of science and technical information activities. The list and the frequency distribution derive from formal replies to this survey.

GOVERNMENT

JOB TITLE	FREQUENCY
Librarian	27
Librarian (Reference)	9
Librarian (Reference-Science)	7
Translator	6
Technical Reports Analyst	6
Reference Librarian	4
Librarian (Cataloguing)	4
Librarian (Trainee)	3
Cataloger	3
Supervisory Librarian	3
Physical Science Administrator	3
Bibliographer (Biological Science)	3
Librarian (Acquisitions-Science)	2
Special Librarian	2
Librarian (Acquisitions)	2
Acquisition Librarian	1
Administrative Assistant	1
Administrative Officer	1
Analyst (Science and Technology)	1
Assistant Chief, Science and Technology Div.	1
Bibliographer and Science Specialist	1
Bibliographer - Assistant	1
Bibliographer (International Geophysical Year)	1
Bibliographer (Physical Science)	1
Chief, Bibliography and Translation Section	1
Chief Cataloger	1
Chief, Domestic Science Reference Unit	1
Chief, Foreign Science Reference Unit	1
Chief, Information Resources Branch	1
Chief, Processing Branch	1
Chief, Reference Branch	1
Chief, Science and Technology Division	1
Chief, Technical Information Division	1
Consultant in Research Information	1
Curator, Science Room	1
Descriptive Cataloger	1
Reviser, Descriptive Cataloguing Section	1
Document (Science) Analyst	1
Geographer	1
Head, Bibliography and Reader Service Section	1
Head, Descriptive Cataloguing Section	1
Head, Subject Cataloguing Section	1
Junior Librarian	1
Librarian (Medical and Biological Science)	1
Library Assistant	1
Literature Searcher	1
Military Intelligence Research Analyst	1

Government cont'd

JOB TITLE	FREQUENCY
Order Librarian	1
Oriental Reference Assistant	1
Oriental Science Specialist	1
Patent Examiner	1
Patent Search Adviser	1
Project Supervisor	1
Science Acquisitions Specialist	1
Science Bibliographer	1
Science Information Officer	1
Science Information Personnel	1
Science Librarian	1
Science Research Specialist	1
Science Specialist (Biological Sciences)	1
Science Specialist (Physical Sciences)	1
Senior Abstractor	1
Slavic Reference Assistant	1
Slavic Science Acquisitions Specialist	1
Slavic Science Bibliographer	1
Slavic Science Reference Specialist	1
Supervisor, Biological Sciences Unit - Bibliography Section	1
Supervisor, Physical Sciences Unit - Bibliography Section	1

INDUSTRY

Librarian	32
Technical Librarian	15
Literature Searcher	10
Literature Chemist	8
Special Librarian	6
Literature Scientist	5
Abstractor	4
Technical Editor	4
Translator	4
Assistant Librarian	3
Cataloger	3
Chemist	3
Indexer	3
Library Supervisor	3
Technical Information Specialist	3
Director of Technical Information	2
Head Librarian	2
Information Specialist	2
Reference Librarian	2
Systems Specialist	2
Technical Writer	2

Industry cont'd

JOB TITLE	FREQUENCY
Assistant Director of Medical Advisory Department	1
Central Librarian	1
Chemist-Technical Information Services	1
Coder	1
Director of Research Information	1
Director, Technical Library	1
Documentalist	1
Editorial Personnel	1
Editor, Scientific Publications	1
General Librarian	1
Head, Information Retrieval Section	1
Information Scientist	1
Library Administrator	1
Library Assistant	1
Library Processes Technician	1
Library Specialist	1
Machine Systems Specialist	1
Manager of Information	1
Manager, Synthetic Intelligence Department	1
Manager, Technical Services Division	1
Nomenclaturist	1
Patent Searcher	1
Reference Assistant	1
Research Assistant	1
Research Files Chemist	1
Research Group Leader for Technical Information	1
Research Translator	1
Science Editor	1
Science Information Specialist	1
Science Writer	1
Staff Librarian	1
Subject Reference Librarian	1
Superintendent, Information and Records Department	1
Supervisor of Information Retrieval	1
Technical Files Supervisor	1
Writer - Analyst	1

RESEARCH ORGANIZATIONS

JOB TITLE	FREQUENCY
Librarian	8
Literature Searcher	5
Science Librarian	4
Science Information Specialist	3
Abstractor	2
Cataloger	2
Chemistry Librarian	2
Information Specialist	2
Reference Librarian	2
Acquisitions Librarian	1
Bibliographer	1
Bio-Sciences Librarian	1
Head, Bibliographic Department	1
Head, Document Operations Group	1
Information Technologist	1
Literature Worker	1
Medical Librarian	1
Public Librarian (Science Division)	1
Science Editor	1
Science Information Personnel	1
Science Technology Librarian	1
Subject Specialist	1
Technical Information Specialist	1
University Librarian	1

Typical job descriptions for science information specialists in the Office of Technical Services, United States Department of Commerce, and the Library of Congress are included in Appendix iv.

6. The information center. The recent increase in scientific research and development activities has stepped up the demands of laboratory and administrative personnel for expanded, more efficient, and better integrated information services. The result has been a trend to unify library, patent, translation, report writing, archival, abstracting, literature research, editorial, communications, and publication activities within a single information facility. In an organized information center better opportunity occurs to classify in-

formation tasks and to estimate job qualifications. The following list of information facilities within government, industry, and research organizations (combined) illustrate the variety of traditional and new facilities. The list and frequency distribution derive from replies to this survey.

FACILITY	FREQUENCY
Library	24
University Library	13
Technical Library	9
Research Library	5
Technical Information Division	4
Technical Information Service	4
Technical Information Department	3
Research Laboratory Library	3
Information Services	2
Medical Library	2
Research and Development Department	2
Science and Technical Division	2
Technical Information Group	2
Abstracting Service	1
Central Reference Division	1
Central Research Division	1
Central Research Laboratory	1
Department of Information Services	1
Information and Data Center	1
Information Division	1
Information Management Division	1
Information and Records Department	1
Information Service Group	1
Medical Advisory Department	1
Patent Department	1
Public Library	1
Research Center Library	1
Research Department	1
Research Division Library	1
Research Information Division	1
Research Information and Planning Department	1
Science Information Department	1
Synthetic Intelligence Department	1
Technical Center	1
Technical Information Center	1
Technical Information Section	1
Technical Information and Liaison Department	1
Technical Intelligence Center	1
Technical Service Department	1

Because of the variety and overlap of function, the distinction between technical and science information has been difficult to establish. At the end of The Symposium on Technical Information, however, the participants reached an agreement on the inclusive title, Science Information Officer. See Appendix v. for an extract of that discussion.

7. Emphasis on Instrumentation. The personnel (or intellectual) problem of science information has attracted less general attention than exotic new instrumentation. Perhaps this lack of an overview has been due to the outcropping of many specific information problems (e.g. detailed subject classification, economical storage, detailed indexing, rapid conversion, rapid translation, improved reproduction and transmission, minimum subject distortion, rapid publication). Many of these difficulties have been worked out discretely without regard for the entire information system. But overcoming single information problems has led often to the creation of new ones. Typical of the lack of perspective in the area of science information has been the tendency by management to allow fundamental responsibility for information services to fall on any willing scientist, librarian, or clerk. Similarly, the selection of a single integrated facility, decentralized units, autonomous centers or main and branch units of information often reflect happenstance and not necessarily good judgment.

There is no one best structure for the organization of the science information function in a government agency, industrial firm, or research organization. There are the variables of competition, company history, nature of the industry, legal statute, business stability, relation of research to production, locality, and personnel. The only architect who can design unique, overall answers to these information problems is the science information specialist intimately familiar with the situation.

III.

RECRUITING: THE PROBLEM OF CHANGING PRECONCEPTIONS

The following tables analyze present and anticipated recruiting needs within government, industry, and research organizations for science information personnel. These figures are based on replies to this survey. Almost all of the 75 industrial firms included appear in the Fortune magazine listing of "The 500 Biggest Industrials" (July, 1960).

PRESENT RECRUITING NEEDS

	Critical Shortage	Difficulty in Recruiting	Making Do With Personnel Available	Adequate Supply	Over Supply	TOTALS
GOVERNMENT	4	5	7	1	-	17
INDUSTRY	6	27	38	5	-	76
RESEARCH ORGANIZATIONS	9	17	14	2	1	43
ALL	19	49	59	8	1	136

ANTICIPATED RECRUITING NEEDS

	Considerable Increase	Some Increase	Little Increase	No Increase	TOTALS
Government	10	7	-	-	17
Industry	32	30	8	6	76
Research Organizations	18	18	1	3	40
ALL	60	55	9	9	133

The following table lists the present and anticipated (where available) staffing requirements for science information personnel (professional and non-professional) in 17 government libraries and 1 government technical information division.

GOVERNMENT STAFFING REQUIREMENTS FOR SCIENCE INFORMATION PERSONNEL: PRESENT AND ANTICIPATED

AGENCY	PRESENT S.I. STAFFING		ANTICIPATED NEEDS IN 5 YRS.		ANTICIPATED NEEDS IN 10 YRS.	
	Total	Prof.	Total	Prof.	Total	Prof.
Coast & Geodetic Survey Library	8	3	8?	3?	8?	3?
Dept. of The Interior Library	23	10	30	13*	40	17*
Federal Communications Commission Library	4	4	6	6*	10	10*
National Aeronautic & Space Agency Library	15	9	15?	9?	15?	9?
National Bureau of Standards Library	18	7	20	8*	25	10*
National Science Foundation Library	3	2	6	4*	8	5*
Naval Observatory Library	2	2	6	6*	10	10*
Naval Research Laboratory Library	40	18	45	20*	50	23*
Patent Office Library	76	30	90	36*	100	39*
Science & Technical Division The Library of Congress	65	46	80	57*	100	71*
Smithsonian Institution Library	26	16	35	13*	40	17*
Technical Information Division Office of Technical Services Dept. of Commerce	68	30	80	35*	100	44*
U.S. Army. Engineer Research & Development Laboratory Information Resources Branch (Library Division)	22	10	22	10	22	10
U.S. Army. Engineering School Library Branch	8	5	8	5	8	5
U.S. Army. Engineers. Snow, Ice & Permafrost Establishment	2	1	2	1	2	1
U.S. Army. Engineers. Waterways Experiment Station. Library Section	8	4	8	4	8	4
U.S. Army Map Service. Library Division	135	68	135	68	135	68
U.S. Army Office of Chief of Engineers. Library Branch	8	4	8	4	8	4
TOTAL STAFFING REQUIREMENTS	527	263	604	312	689	358

?= could not project needs, therefore present staffing extended for 5 and 10 years.

*= estimate of professionals based on present ratio of professionals to total staffing.

Variables Influencing Recruiting

1. Desirable Characteristics of Science Information Personnel.

In this profession each position requires a unique combination of at least two of the following qualifications:

a. subject knowledge;

b. professional library education and experience;

c. administrative ability and experience;

d. knowledge of non-traditional information systems and instrumentation;

e. foreign language proficiency.

What needs to be stressed is the scope of this profession, the intellectual stimulus, and the variety of opportunities it affords men and women for using their training, knowledge, and imagination. At every step of the information process there is a need for evaluation of the information and at the last step an opportunity to interpret materials to facilitate their use. For example, a science information specialist with an undergraduate major in chemistry, a library school degree, and a reading knowledge of German might qualify for special library work in a medium-sized industrial chemical firm. The head of information of a pharmaceutical research center might need a masters or doctors degree in organic chemistry, extensive administrative experience, reading knowledge of two foreign languages, and a familiarity with computers and mechanized retrieval techniques. A bibliographer and literature searcher for a missile manufacturer might offer a bachelors or masters degree in physics or engineering, acquaintance with certain library skills, and a reading knowledge of Russian; while the literature scientist for a petroleum research center might be a Ph.D. in chemistry who knows how to translate from Russian and French. A thumb-nail sketch of a science information specialist might describe him as one who processes and transmits the intellectual content of recorded scientific and technological information. He has interest, education, and training in one or more scientific disciplines together with their literatures and appropriate foreign languages, interest in the logic, language, and mechanics of intellectual operations, appreciation of the role of recorded knowledge in the development of civilization, knowledge of the theory and practice of the processes of the information cycle, and commitment to serve the specialized needs of his clientele. See Appendix [illegible] for detailed job descriptions.

2. Management's View of Information. Highly competitive firms (see Appendix I) that constantly probe for new markets, and new uses for their goods and services are usually alert to the advantages of information facilities. To quote the view of one research director,

> Major oil and chemical companies within the past half decade have established information divisions combining the library, information services, information research, and even public relations functions. This new component of industrial research—the information division—is a "many splendored thing." It can be an Associated Press, a Western Union, a McGraw-Hill, and a McKinney & Company all rolled into one. What the research director has in the present day information division is a veritable Aladdin's lamp. Rubbed the [illegible]

In addition to supplying information services, the division may also produce many fine candidates for promotion to staff positions.

> In our experience the information specialist has unusual opportunities for advancement in the organization. The information scientist is first of all thoroughly trained in his own subject specialty, and in addition gets from his job experience which few other jobs can match in breadth and exposure -- he works with people in the laboratories, in clinical development, with the marketing people, and of course with administrative people in many areas. Several of our information scientists have been advanced to scientific staff positions at Smith Kline & French, primarily because of the background and reputation gained during their contacts in information work.

Despite these long-range benefits, management for any number of reasons sometimes fails to realize the potential of its libraries and other information facilities. There is the tendency, for example, to measure departments by their dollars and cents productiveness. The quantitative measure may be essential in sales, advertising, and sometimes in the laboratory, but service output is like the north star, "whose worth's unknown, although his height be taken." Failing to determine the quantitative measure and sometimes ignoring the qualitative one, some institutions are ready to believe the worst and the librarian in the eyes of management too frequently seems to be linked merely to custodial duties and, as a result, apt to incur limitations in status and reward. As a result of this attitude, the information section sometimes becomes a place for misfits who are moved there without additional training. Without defining the information function, management often asks the information specialist to perform more than he is able or less than he can.

3. The Scientist's View of Information. As with management, the attitude of the scientist to information services is dependent on previous experience. All scientists have an obligation to find, evaluate, and synthesize information. But the relative importance of information techniques to the scientist depends on (a) the concentration of the scientist's time in laboratory, literature or field work; (b) the theoretical or applied nature of the scientist's work; (c) the scope of his scientific interest; (d) the competition for information; (e) the adaptability of the information facility and its staff to the needs of the scientist; (f) the recorded form, language, and security restrictions used by other scientists working in his discipline.

To expect scientists to do much of their own literature searching is normal, but this expectation should not be accompanied by complacency. To quote one Columbia professor, "If you analyze the information-gathering habits of scientists, it makes your hair stand on end." On the other hand, the reluctance of the scientist to turn over a search to an information scientist is understandable. The scientist has his own concept of what he wants and he often lacks confidence in the information specialist's intuitive grasp of the subject.

But the separation of the information specialist from any but routine tasks will cut off in time a necessary service link between one creative scientist and another. The information specialist must earn his spurs, but his way will be made easier if the scientist, the engineer, and the mathematician accept him to membership on the team on a basis of equality. The scientist, in turn, will learn more about information handling and gain for himself a valuable follow-up on leads that he himself has not the time to pursue. With a strong information ally, the scientist will experience less frustration in trying to keep abreast of mounting information, appearing in increasingly eccentric forms. The scientist then as well as management, has an interest in seeing that first class professionals enter this profession.

IV.

RECRUITING AND UNDERGRADUATE EDUCATION

Faculty and administration of undergraduate institutions have an obligation to describe information work as part of a discipline and as a career possibility. Professors of science and language and the college librarian are in a unique position to advise qualified students to consider a career in this area -- not as a way out of a discipline for a poor student, but as a profitable alternative to laboratory work or teaching for a good one. A similar burden rests on the high school teacher, counselor and librarian, and even parent, to place in perspective the information requirements of all disciplines. Yet the fact remains that there are no recruiting programs to inform and very little exposure to the practical work of information for the undergraduate. Industry, government, library schools, and professional associations might well offer further assistance by preparing materials describing the opportunities in information work. In its way this exploratory study describes the nature and degree of need for science information personnel, and in what follows suggests a program of education and training for science and language majors.

The Science Major

The Symposium reached complete agreement that the basic need of the science information specialist was a well-rounded liberal education with a major in science. The fundamental undergraduate courses in the humanities (history, literature, philosophy), science, and language including mathematics still afford the best opportunities for challenging the intellect, creating purpose, and providing the foundation and discipline for achievement. The point is that the science information specialist must be educated for breadth of view. He or she may major in one science or a cluster of sciences.

Not only are the laboratory scientist and science information specialist both served by a similar general education, but there is mutual gain when each has education and training in the specialty of the other. The general neglect of the literature sources in undergraduate science courses is gradually being overcome. Some institutions have successfully introduced elective courses in the use of the literature usually in chemistry, although the most generally workable solution seems to be incorporation of literature knowledge within existing courses.

On this base of general education, the science information specialist needs to build knowledge of his scientific discipline and at least reading skill in two foreign languages. The table below illustrates the relative importance of these backgrounds for science information specialists in government, industry, and research organizations.

RELATIVE IMPORTANCE OF BACKGROUNDS IN SCIENCE INFORMATION WORK

Government Replies

	1st Priority	2nd Priority	3rd Priority	Unimportant	Totals
SCIENCE DISCIPLINE	62	12	2	-	76
LIBRARIANSHIP	45	34	7	4	90
FOREIGN LANGUAGE ABILITY	25	8	17	2	52
INFORMATION WORK	17	25	6	3	51
	149	79	32	9	269

Industry Replies

	1st Priority	2nd Priority	3rd Priority	Unimportant	Totals
SCIENCE DISCIPLINE	137	17	3	-	157
LIBRARIANSHIP	40	47	9	11	107
FOREIGN LANGUAGE ABILITY	23	51	55	3	132
INFORMATION WORK	33	54	9	3	99
	233	169	76	17	495

Research Organization Replies

	1st Priority	2nd Priority	3rd Priority	Unimportant	Totals
SCIENCE DISCIPLINE	57	16	-	-	73
LIBRARIANSHIP	28	23	6	4	61
FOREIGN LANGUAGE ABILITY	22	20	23	1	66
INFORMATION WORK	28	5	3	-	36
	135	64	32	5	236

The heading "First Priority" includes requirements judged to be of primary and/or equal importance by the experts answering the survey. Other headings are self-defining. These tables were summarized in the introduction.

The Language Requirement

The table below describes the relative importance of foreign languages in information work and the degree of facility preferred within government, industry, and research organizations replying to the survey.

FOREIGN LANGUAGE FACILITY REQUIRED IN SCIENCE INFORMATION WORK

	Complete oral & translating facility	Translating facility	Reading facility	Some knowledge - "puzzle way through"	Totals
GERMAN	5	45	103	17	170
FRENCH	2	41	93	21	157
RUSSIAN	4	37	61	13	115
CHINESE	1	8	18	2	29
JAPANESE	2	2	19	2	25
ITALIAN	-	7	15	6	28
SPANISH	1	3	4	3	11
DUTCH	-	-	1	-	1
	15	143	314	64	536

Translating facility is essential for translators and abstractors; reading facility is a minimum for literature scientists, and some knowledge of a foreign language is helpful in screening, cataloguing, indexing, and scanning. Although a slight reading knowledge of several foreign languages has proved helpful to librarians performing bibliographical tasks and scientists puzzling out the relevance of a title or an article to his work, neither man can afford to linger over difficult material. Without a certain level of facility in translating it becomes economically unwise to translate a difficult article when a translation can be bought in ready form more cheaply. This caution is not to discount the desirability of the information specialist and the information scientist knowing how to read at least two foreign languages; rather it suggests that these languages need to be learned well early in life. Facility in foreign language is always a plus factor in information work. Lack of foreign language skill is sometimes a handicap in information work and may become more so. In the opinion of 117 respondents to this survey, the degree of need for modern foreign language facility in information work is as follows:

Critical Need	32
Growing Need	43
Need Met	36
No Need	6

Several replies gave particular attention to the growing need for Chinese and Japanese language skill in information work. Many replies stressed and exemplified the importance of a clear, logical, and concise writing style. Five replies recommended Latin as the foundation for modern foreign language study.

The Language Major

It is quite obvious that the subject specialty is the primary background required for science information work. The language major, however, eventually may become a valuable professional in this field, if as an undergraduate he rounds out his education with basic courses in the sciences, mathematics, and logic. He will also need to complete at least one year of graduate school. See chart on page 29 below. He may find employment then as a special librarian, abstractor, translator, literature scientist, or perhaps ultimately as a developer of information systems. The critical need for the latter is underscored in a statement by a director of university libraries.

> Research in mechanical translation requires the grammarian even more than the engineer. And it is safe to say that further advances in information retrieval must now await progress in the vocabulary and techniques of indexing. Recent experiments in automatic abstracting base their approach on the frequency of key-words, the correlation of synonyms, etc. This clearly involves the language specialist.

V.

RECRUITING AND GRADUATE EDUCATION

The following chart lists the graduate programs (existing and proposed) that might prepare a science or language major for information work.

GRADUATE EDUCATION IN SCIENCE INFORMATION

SCIENCE MAJOR (B.S.)			LANGUAGE MAJOR (B.A.)-(with courses in science & math.)	
FIRST YEAR GRADUATE SCHOOL	DEGREE	QUALIFY FOR POSITION AS:	DEGREE	QUALIFY FOR POSITION AS:
School of Science Information (proposed)	M.S. in Science Information	Science Information Specialist Special Librarian Bibliographer Abstractor Literature Searcher Administrator of Science Information facility Cataloger Acquisitions Specialist Reference Specialist Information Officer Technical Editor and Publications Specialist Documentalist Coder Indexer Nomenclaturist	M.S. in Science Information	Translator Bibliographer Science Information Specialist Cataloger Indexer Nomenclaturist Technical Editor and Publications Specialist Language Specialist for Information Systems Development Administrater of Science Information Facility Acquisitions Specialist
School of Library Science	M.S. in Library Science	Special Librarian Subject Cataloger Subject Reference Specialist Bibliographer	M.S in Library Science	Special Librarian Descriptive Cataloger Editorial and Publications Work Translating Work General Reference Work
Graduate Department of science, with a minor in information work, library science courses or in-service training in information work	M.S.	Literature Scientist Nomenclaturist Abstractor Literature Searcher Coder Indexer		

	SCIENCE MAJOR (B.S.)		LANGUAGE MAJOR (B.A.)-(with courses in science & math.)	
DOCTORAL PROGRAMS	DEGREE	QUALIFY FOR POSITION AS:	DEGREE	QUALIFY FOR POSITION AS:
School of Science Information (proposed)	Ph.D.	Developer of Science Information Instrumentation Systems Developer Planner of Information Facilities Researcher in Science Information Theory and Methods Professor of Science Information Administrator of Science Information Facility Coordinator of Science Information Activities for Government, Industry, Research Organizations	Ph.D.	Administrator of Science Information Facility Systems Developer Publications Specialist Professor of Science Information
School of Library Science Major in Science Library Work	D.L.S. or Ph.D.	Teacher of Science Librarianship Administrator of Science Library Researcher in Science Librarianship and Bibliography	D.L.S. or Ph.D.	Teacher of Science Librarianship Administrator of Science Library Researcher in Science Librarianship and Bibliography
Graduate Department of Science with a minor or a research project in the literature of the science discipline (proposed)	Ph.D.	Evaluator of Science Information Interpreter of Science Information Science Information Scout Literature Scientist Liaison Scientist between laboratory and information facility Information Researcher		

Library Schools

The library schools are the only existing institutions for the formal education of information specialists. The schools have traditionally developed the basic library skills (locating, selecting, acquiring materials, cataloguing, etc.), cultivated a professional attitude of service, and introduced the graduate student to historical and theoretical points of view. Over thirty accredited library schools offer courses or programs that prepare individuals, at least in part, for a career in science and technical information work. For a more detailed summary, see Appendix V. Some library schools have become, in addition, a meeting ground for special institutes and conferences on scientific information and also have sponsored basic research in the development of information systems and the investigation of machines. Their ability to provide education for science information specialists has been limited, however, by a long-standing commitment to academic and public libraries where careers are assured. These general collections usually amassed over long periods of time through philanthropic or public funds bear little resemblance to the highly specialized, quickly assembled, and elegant information requirements of industry and government. While some elements of information work remain the same in both environments, by and large, science information involves additional elements, a more intensive subject analysis, and a more specialized clientele.

To see the information specialist as exclusively a librarian is discourage other qualified personnel from information work, limit the number of potential library school students, and encourage a stereotype in the minds of scientists. The role of the librarian has been to keep a facility complete, efficient, up-to-date and accessible. The information specialist has been concerned more with promoting information, anticipating user requirements, and setting up special information services to meet them. The information specialist has had an advantage over traditional librarians because of his ability to evaluate and interpret scientific material, his consequent acceptance among scientific peers, and his ability to draw funds for an information facility. He has wide acquaintance with his material on one hand and with his user colleagues on the other. He has been influential in introducing many graphic services and machine techniques which require new technical personnel within the information center. Because he has enhanced the information function, new needs for library and information center administrators have also arisen. The importance of this more active approach to information is reflected in Dr. D'Ouville's discussion of the information team at Standard Oil of Indiana.

> The size of the information team--including the library staff--varies in proportion to the size of the total professional research staff. A study of a number of organizations indicated that a research staff of 500 will require about two dozen on the information team, whereas a very large research organization of 1500 should have about 80 working on its information problems.
>
> A convenient and effective organization of a 25 man information team would comprise three groups of equal size and a manager. The library group would maintain the information holdings and handle requisitions, ordering, distribution, and loaning. The information reporting group for surveillance and communication would scan periodicals, patents, etc., and transmit condensed information via bulletins and news reports. The searching and information research group would ideally handle problem-solving and searching by using the literature, patents, and internal information. All three groups would report to a manager who would be free to redistribute effort on short notice and authorize expenditures for outside help.

There are four distinct groups then who need new formal graduate education in information: the literature scientist, the information specialists (who operate the new complex of information services), the special librarians, and the administrators who will come after long experience from one of the other three groups. Is it possible to design a new graduate curriculum that will be basic to the three principal groups, educationally sound, intellectually stimulating, and acceptable to the users?

First, however, one must ask oneself, whether the need for formal graduate education in information is apparent or real? The library schools continue to function with some adaptations to special librarianship. The science major and the library school graduate find their way at present into industry and government information facilities and are then trained on the job. Is there then any justification for formal graduate education in special library and science information techniques designed for the science or language major? Yes. The recruiting problem alone would suggest that users of science information require formal programs for the formation and development of science information specialists. Here is an insistent demand with no adequate supply.

Assuming that no library school can turn out a full-fledged journeyman after one year, and assuming that many users' requirements can best be learned on-the-job, there still remains the need for a reliable source of recruitment sufficient in number, quality, and diversity. As they are at present constituted, library schools fail to provide this source for industry and government information facilities. Says one university librarian,

> From time to time I do have a student who works for me interested in library work, but, when he sees the library school curricula and also the salaries offered, he backs away. When beginning salaries for engineers are more than those for beginning professional librarians, it is hard to sell librarianship.

Commenting on the results of such apathy, another university librarian reveals that,

> We now succeed with little trouble in filling all our professional posts, but we do so by not requiring skills that ought to be required, and by meeting instead the legal requirements of the possession of an M.L.S. which excludes some persons with skills we need and admits many without these skills.

Lowry of Bell Laboratories also discusses the stereotype of librarianship and suggests an alternative.

> There is an unfortunate connotation attributed to library school training which, rightly or wrongly, detracts from the reputation of those engaged in information work. Most of the graduates of library schools are employed in public libraries. This type of library also employs a large number of people who have no professional training at all, but in the minds of library users they represent the library profession. The image of the librarian is thereby distorted but it is still a widely accepted image and it will not disappear for many years. I think we should establish a curriculum for science information work better suited to the requirements of modern science and that the degree should not be a Library School degree. This should assist in attracting the type of student required and will help overcome the low professional esteem presently accorded Library School graduates by the scientific community generally.

But to state that library schools have a more or less set program of librarianship and that users make do with personnel available only begins to picture the inertia which retards any new educational development. There is, for instance, little common agreement among management, scientists, educators, and information specialists on modifications of present library school curriculums that would make them suitable to industry and government requirements. There is little chance of getting a consensus primarily because there is no forum where users (scientists and management), processors (special librarians and other science information specialists), and educators have an opportunity to plan and consider the elements of a formal graduate program. But assuming a consensus, there is just too little incentive for a scientist already well qualified in one discipline to continue his education at the expense of professional experience and economic security. His unwillingness is re-enforced if he believes that the study of science information is not an intellectual discipline, but a series of routines acquired more quickly on the job. Finally, library schools lack the necessary funds for research, experimentation, development, and recruitment.

A New Graduate School of Science Information

To solve the recruiting problem, to overcome the factors causing inertia, and to educate the information specialist more efficiently, the Directors of this project recommend a new graduate school of science information and a one year graduate curriculum.

Degree: Master of Science in Information

Duration: Two semesters and a summer session

1. CURRICULUM

First Semester

SCIENCE INFORMATION 1. Information Sources: Biological Sciences and Medicine.
SCIENCE INFORMATION 3. Information Sources: Physical Sciences and Mathematics.
SCIENCE INFORMATION 6. Acquisition of Science Information.
SCIENCE INFORMATION 7. Description and Subject analysis of Science Information, Part I.
SCIENCE INFORMATION 11. Reference Work and Retrieval of Science Information.
SCIENCE INFORMATION 13. Science Information Theory and Systems Development.

Second Semester

SCIENCE INFORMATION 2. Information Sources: Chemistry
SCIENCE INFORMATION 5. Science Information Center Administration.
SCIENCE INFORMATION 8. Description and Subject Analysis of Science Information. Part II.
SCIENCE INFORMATION 9. Abstracting and Annotating Science Information.
SCIENCE INFORMATION 12. Language and Science Information.
SCIENCE INFORMATION 14. Science Information Instrumentation.

Summer Session

SCIENCE INFORMATION 4. Information Sources: Engineering.
SCIENCE INFORMATION 10. Graphics and Publication.
SCIENCE INFORMATION 15. Theory and Practice of Information Interpretation and Research.

SCIENCE INFORMATION 1. Information Sources: Biological Sciences and Medicine.

This course is an intensive study of the published and non-published sources of biological and medical information: their identification, nature, variety and utilization.
Topics: the organization and terminology of these disciplines; reference works and typical publications; publishing and information-creating patterns; criteria, techniques and tools for selection of materials; unique requirements and habits of information users in these fields; research organizations, societies, industries and government agencies concerned with information in these fields; history and nature of research in these fields.

SCIENCE INFORMATION 2. Information Sources: Chemistry.

SCIENCE INFORMATION 3. Information Sources: Physical Sciences and Mathematics.

SCIENCE INFORMATION 4. Information Sources: Engineering.

See Science Information 1 for description.

SCIENCE INFORMATION 5. Science Information Center Administration.

This course is a study of the administration and management of science information center operation. Topics: organization of facilities for service; relations with parent organization-governmental, industrial, research; public relations and publicity; budget and finances; personnel; physical plant maintenance and operation; planning; reporting; cooperative activities with other centers; coordination and evaluation of services; professional organizations in science information.

SCIENCE INFORMATION 6. Acquisition of Science Information.

This course is a study of the theory and techniques of locating, identifying, and acquiring recorded and unrecorded units of information. Topics: scouting information not in published form; ordering, purchasing, and exchanging procedures; structure and dynamics of information-creating agencies such as government agencies, industry, publishers, associations; acquisitions problems of special forms of information: patents, reprints, documents, technical reports, classified materials, microforms; copyright law; international publications field; bibliographic tools.

SCIENCE INFORMATION 7. Description and Subject Analysis of Science Information. Part I.

SCIENCE INFORMATION 8. Description and Subject Analysis of Science Information. Part II.

This two semester course is devoted to the theory and practice of *descriptive cataloging* (the identifying and characterizing of a unit of information by bibliographic criteria and organizing it in a methodical arrangement) and *subject analysis* (identifying and characterizing a unit of information on the basis of its intellectual content and organizing it in a methodical subject arrangement). Topics: bibliography; cataloging rules and procedures; classification and subject headings; indexing; Library of Congress, Dewey Decimal, U.D.C., uniterm, coordinate indexing and other systems; intensive practice in cataloging and subject analysis using existing systems; storage and preservation of information in its original form and in photographic, mechanical and electronic substitute forms.

SCIENCE INFORMATION 9. Abstracting and Annotating Science Information.

This course is a theoretical and practical study of the processes of summarizing the bibliographic and/or subject content of information in concise form. Topics: types of abstracts and annotations; study of existing published abstracts, abstracting services and techniques of abstract construction; mechanization of abstracting; user requirements of abstracts; abstracting problems of the various scientific and technological disciplines; intensive practice in the preparation of abstracts, annotations and summary reports; preparation of abstract bulletins.

SCIENCE INFORMATION 10. Graphics and Publication.

This course is a study of the procedures and techniques of publication preparation and of graphic representations found in science information centers. Topics: printing and photo-reproduction techniques; preparation of copy; editing; technical writing; duplicating techniques and equipment; layout; composition techniques and equipment; charts, graphs, drawings, tables, and maps: their treatment; book and report production.

SCIENCE INFORMATION 11. Reference Work and Retrieval of Science Information.

This course is a study of the public service and information retrieval functions of science information work. Reference work involves meeting the needs of users by joining a knowledge of the resources of the center to an analysis of the specific information requirement. Literature searching involves the review, location, identification, compilation, and retrieval of units of information related by subject, bibliographic and/or user criteria. Topics: circulation and loan procedures and systems; bibliographic forms and preparation of bibliographies; searching and retrieving procedures, tools and devices; intensive practice in planning and carrying out literature searches, compilations, state-of-the-art surveys, reference questions, research projects; study of information gathering and searching habits of scientists, engineers and other users.

SCIENCE INFORMATION 12. Language and Science Information.

This course is a theoretical study of the place of language in science information activities and a practical study of foreign language scientific translation. Topics: relation of linguistics, philology and **semantics** to the theory and structure of information systems; scientific nomenclature and terminology; normalization of language; theories of meaning; compilation of thesauri; mechanical translation; vocabulary of indexes; scientific dicionaries; theory of translating and intensive practice in translating from one language into another (depending upon degree of students' foreign language proficiency).

SCIENCE INFORMATION 13. Science Information Theory and Systems Development.

This course is a study of the history of scientific communication and of the theory of the processes and cycle of information. It draws upon many disciplines and techniques for an understanding of how integrated information systems are developed, operated and evaluated. Topics: history of scientific research; relation of symbolic logic, mathematics, electronics, information theory, linear programming, data processing, library science, industrial management, statistics, etc., to science information systems; coordination of the elements of the information cycle into an efficient system; system evaluation; cost analysis; time and motion study applied to systems; practice in planning integrated systems to meet typical requirements.

SCIENCE INFORMATION 14. Science Information Instrumentation.

This course is designed to familiarize the student with the typical manual, mechanical, electronic, and photographic instruments, equipment and devices used in science information work. Topics: microfilms; electronic and electro-mechanical wires, tapes, films, relays; card catalogs; vertical files; mechanical sorters: Zatocards, notched cards, Peekaboo systems; electronic sorter: rapid selector, Luhn, microcards, IBM 704; Western Reserve searching selector; transmission devices: facsimile, Ultrafax; data processing equipment; manual files; book catalogs; computers; evaluation of instrumentation; development and modification of instruments.

SCIENCE INFORMATION 15. Theory and Practice of Information Interpretation and Research.

This course is a theoretical and practical study of the principles and techniques of evaluating the significance, pertinence and relevance of scientific publications for particular research requirements. Practice in information interpretation will be performed in the area of the individual student's greatest subject competence. Attention will also be given to practice in solving scientific research problems by the use of the documentation and without benefit of experimental or laboratory processes.

2. Justification for Curriculum

The courses are a direct reflection of the 17 elements of science information agreed upon by the participants in the Symposium on Technical Information Personnel. See Appendix iv. They are, moreover, based upon an analysis of correspondence, interviews, and the literature. See graph on page 5 above.

The following chart relates each course to the elements of information work.

SCIENCE INFORMATION COURSE NUMBER

ELEMENTS OF INFORMATION WORK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Administering					x										
2. Locating materials						x									
3. Selecting materials	x	x	x	x											
4. Acquiring materials	x	x	x	x		x									
5. Descriptive cataloging							x	x							
6. Subject analyzing including classifying, subject heading, and indexing	x	x	x	x			x	x						x	
7. Abstracting and/or annotating	x	x	x	x					x						
8. Performing reference work	x	x	x	x							x				
9. Literature searching - bibliography	x	x	x	x							x			x	
10. Transmitting and copying										x				x	
11. Translating												x			
12. Converting into machinable form													x	x	
13. Developing of information systems												x	x		
14. Investigating of machine applications													x	x	
15. Information interpreting	x	x	x	x											x
16. Researching with information	x	x	x	x											x
17. Information scouting	x	x	x	x		x									

3. FACULTY AND EQUIPMENT NEEDS

S.I. 1, 2, 3, 4

Faculty: Instructors with training in the appropriate scientific disciplines; training and/or experience in science librarianship; extensive and up-to-date experience in acquiring, processing, and servicing the information resources of the discipline for a large, well-organized information center.

Equipment: A large, well-organized science information center or library which has in its collections examples of all of the basic classes of information sources.

S.I. 5

Faculty: An instructor with broad experience and acquaintance as an administrator of industrial, government and/or research organization science information centers of varying sizes.

S.I. 6

Faculty: An instructor of librarianship with experience teaching acquisitions, plus knowledge, and preferably, recent experience in acquiring scientific materials for a large information center serving several science disciplines or a large university or research organization library.

Equipment: See S.I. 1,2,3,4 above.

S.I. 7, 8

Faculty: An instructor of librarianship with experience teaching traditional cataloging and classification; plus experience and acquaintance with the latest non-traditional theories and schemes for indexing, subject analysis, and classification.

Equipment: See S.I. 14 below.

S.I. 9

Faculty: An instructor with broad, varied, and intensive practical experience as a science abstractor.

Equipment: See S.I. 1,2,3,4 above.

S.I. 10

Faculty: An instructor with training and experience in the graphic arts and technical editing.

Equipment: A laboratory equipped with examples of the latest graphic arts, duplicating, and publication preparation instruments.

S.I. 11

Faculty: An instructor with experience teaching science library reference work and broad experience as a literature searcher and bibliographer in a science information center.

Equipment: See S.I. 1,2,3,4 above and S.I. 14 below.

S.I. 12

Faculty: An instructor with broad foreign language proficiency and training in philology and linguistics, with special reference to science language problems. Preferably experience with science translation.

Equipment: A collection of foreign language science publications in the various disciplines; a language laboratory for increasing foreign language proficiency.

S.I. 13

Faculty: An outstanding science information specialist who is both a profound creative thinker, a broadly experienced practitioner, and an inspiring teacher. This person must have an established reputation through publications, administrative accomplishments, or creative achievements as a theoretical and philosophical leader in the science information field.

S.I. 14

Faculty: An experienced practitioner in science information work, preferably in industry, with wide acquaintance with the theory and application of the latest manual, mechanical, photographic, and electronic instrumentation. Some knowledge of electronic and computer theory essential.

Equipment: A laboratory with examples of the latest instrumentation used in science information centers. These instruments should, ideally, be in actual operation in a working science information center.

S.I. 15

Faculty: An outstanding literature scientist with broad experience in laboratory research work and literature science work; preferably a Ph.D. in chemistry, biochemistry, or physics.

Equipment: See S.I. 1,2,3,4 and S.I. 14 above.

This basic one year program is devised with the assumption that no one can pretend to turn out a journeyman at the end of one year of graduate preparation, but that these graduates, nonetheless, would be motivated, educated, employable, and promotable. The recruits for this formal program would come from undergraduate and other graduate institutions and also from among qualified librarians, scientists, linguists, and other information specialists who are recommended by their employers or who apply of their own volition. Such a program and the research and administration leading to it would need to be underwritten initially by its ultimate beneficiaries - the users and the public.

Two Ph.D. Programs

Advanced studies in information science divide into two logical branches:

1. Systems development including information processing research, the development of systems and investigation of machines.

2. Literature science including interpretation, information research, and information scouting. A graduate of the former program would become an information specialist; a graduate of the latter would become an information scientist.

1. Systems Development.

Paradoxically, the empirical development of science information has brought significant advances in theories of communication and increased the need to find creators among processors of information. The newer elements of information processing (i.e., the development of comprehensive information systems, investigation of machines) require the profound attention of a graduate faculty who have time and inclination for basic research and a body of doctoral candidates who acquire a comprehensive knowledge of the cycle of information and will devote time to solving research problems. These higher studies recommend an extension of the first year graduate school of science information drawing on a student body of computer engineers, logicians, linguists, librarians (all with strong subject backgrounds). Research problems would be in such areas as: identifying the information requirements of scientists; devising principles of organizing and classifying knowledge; devising information systems, both manual and mechanical; analyzing the components of the cycle of information; analyzing the operation of information producing and consuming institutions in our society.

Continuance of the creative process depends on the efficiency of the information process. Information travels the bridge of language; therefore, no traditional term comes closer to describing the problems of the information process than philology. In each of its three meanings, philology applies: (1) the study of written records, especially library texts, in order to determine their authenticity and meaning, (2) the love of learning and literature, and (3) linguistics.

The love of learning usually implies a commitment to broadly communicate this love and therefore requires means of converting information from one language and value system to another. To facilitate the flow of information, to act as liaison between the creator and the user is a labor of love, an act of service. It is the philologist who cuts down the loss factor in converting information from one system to another by articulating precise meanings and communicating a love of learning in the process.

2. Literature Science.

Universities are not solely educational institutions. They also serve as centers for research and for the organization of knowledge. With the expansion of knowledge within many scientific disciplines, the universities can no longer lag behind industry and government in the development of their information facilities. Granted that in some areas of basic research the information requirements will always be limited, still university educators might profitably consider (1) the building of specialized information centers for at least one appropriate scientific discipline, and (2) training scholars to fully develop and exploit the center's information potential. As encouragement for this development, doctoral candidates in a scientific discipline might be permitted dissertation projects relevant to the science and to its literature sources.

The division of these two basic Ph.D. programs (Systems Development and Literature Science) might overcome the practical difficulties encountered in setting up interdisciplinary programs, yet allow enough flexibility for occasional teams of faculty or student researchers from each of the two areas to work cooperatively on a single research problem.

There are only a handful of qualified experts who could map out the specifics of these doctoral programs. Among other obstacles to such doctoral work are: (1) the selection of a specific university or a research center (similar to the Brookhaven Program in the atomic energy field), and (2) the resources to furnish faculty and technical equipment. As to the importance of Ph.D. programs in science information, one has only to look to other professions to see the relationship between basic research and performance. In the words of one research director,

> I would like to say that I think industry desperately needs this kind of graduate in its information services but few, if any, are available.

VI.

OTHER EDUCATION AND TRAINING

On-the-job Training

Assuming the continued recruiting of information specialists by present means and the possible acceptance of a new one year program, there still remains the large area of education (course work and research) and training beyond employment. There is, of course, no substitute for on-the-job experience, and all junior scientists would benefit from sequential experience in the laboratories or plant and literature areas, whatever their ultimate professional place.

There is, at present, a wide variety of information training and education offered beyond the fifth year that is neither well-publicized nor evaluated. These formal training programs are necessary on a number of counts. There is continuing need to introduce newly transferred scientists to the techniques of the science information department. There is existing and continuing need for refresher courses, short-term institutes on machine methods, administration of information systems, intensive courses in language, mathematics and logic seminars, conferences and study groups on new developments, and finally basic research in the development of information systems.

The increasing number of such training programs stems from a variety of sources - educational, professional, governmental, and industrial. This growth recommends the establishment of some formal structure to publicize and report on the availability of these programs and encourage the sponsorship of additional ones. Such a coordinating agency would be able to bring together more efficiently (1.) user requirements, (2.) information on new developments, and (3.) the training facilities. Out of these short-term institutes and seminars might come the framework for established instructional programs. The most important of these educational needs is the development of basic research that would advance the theoretical science of information and lead ultimately to recognized Ph.D. programs mentioned above.

The Technician

> These are the people who maintain the administrative and technical files of the division, who operate machines used in the information process, and who back up our professional library staff. In all cases their work is directed by junior or senior personnel with some basic training in science, and usually in some other discipline as well, such as library administration or electronics.

The technician can pick up the slack in an information or library facility and at the same time further his own intellectual and personal goals. A boon to industry and government is the rapid development of community colleges to train these scarce technicians. Information facilities have a special interest here and a recruiting source not yet tapped. A two-year community college program for information technicians could offer the basic sciences and humanities with stress on clerical skills and specific information techniques (e.g. photo-reproduction, computer principles and repair, punchcard operation, library circulation, and other routines). On the job, the technician could be more specifically trained, and if need be continue his pre-professional education through part-time studies. Women in particular could be employed to good advantage here.

VII.

THE FUTURE OF SCIENCE INFORMATION

Recommendations

1. Management

   a. See the library and information center as an intellectual resource with service versatility.

   b. Adopt salary structures consistent with the education and experience of the special librarian or other information specialist. These salaries should be equivalent to salaries for laboratory scientists with similar qualifications.

   c. Coupled with the above recommendation is the need for the establishment within the Federal service and elsewhere of more appropriate job classification standards for scientific or technical information or documentation specialists.

   d. The status of information work and thus the demand for the facilities would be increased if all junior scientists and other personnel spent some time in information research.

   e. Management has a further obligation to encourage the use of the library among its senior professionals.

   f. A senior executive officer, usually in Research and Development, should oversee and continually review the work of the department.

   g. There is a long-standing need for industry and government to cooperate more fully with library schools and other institutions in making provision for time off, with or without compensation, so that people may attend courses. Management should arrange with library schools for special short training courses, institutes, and seminars.

2. The Professionals

   a. The scientist should develop a proper concern for the information facilities particularly as they pertain to his discipline.

   b. The scientist has an obligation to recognize the contribution of information personnel and to acquaint these personnel with his special requirements.

   c. Scientists and information personnel should write in general and science journals more articles of worth and reports of investigations on information problems, solutions, and projects.

d. Information personnel have an obligation to improve liaison with their users and increase the variety and quality of their services.

e. Librarians can improve recruiting if they emphasize the scope of information activities and their professional concern with the intellectual content of what they process.

3. University Faculties

Some undergraduate institutions have already contributed substantially to the development of science information specialists. All departments of science and language and the library need to fully appreciate the relevance of this profession to the national interest and to their own disciplines. There are specific ways in which faculties may help.

Science

a. Recognize the importance of the historical and literature orientation in undergraduate science courses. Emphasize the information approach to solving problems, research, etc.

b. Recommend a broad liberal arts education as the best intellectual preparation for a science information specialist.

c. Recognize the primary importance of a major in a scientific discipline for the preparation of a science information specialist.

d. Encourage some science majors to study several sciences in differing combinations so as to train a science generalist. Point out opportunities in information work for these people.

e. Science professors and librarians should inform students of vocational opportunities in science information.

f. In order to train and familiarize science majors with information processes, science libraries should be demonstration information centers.

Language

a. Recognize reading skill in two foreign languages as a minimum requirement for all scientists.

b. Language teachers and librarians should inform qualified language students of vocational opportunities in the information field.

c. Recognize the continued importance of German and French; the growing, and perhaps critical, importance of Russian, Chinese, and Japanese; and the value of Italian, Spanish, Dutch, Scandinavian, and Portuguese (among others) in carrying on the work of the scientific and engineering disciplines.

4. Graduate Faculties

a. The Directors recommend the establishment of one graduate school of science information offering an M.S. in Science Information, developed by scientists, librarians, library school faculty, management, and science information personnel, established at a single large university already possessing strong science departments. The curriculum would be designed to attract and recruit undergraduates with majors in science, majors in language, with science backgrounds, graduate scientists, librarians from other fields with some science training, workers already in the profession, and prospective special librarians.

Such a program would require industrial, governmental, and academic support to provide for: (1.) research and development, (2.) faculty, (3.) fellowship and scholarship funds, (4.) work-study programs, (5.) recruiting, and (6.) placement.

b. The Directors also recommend research leading to the construction of a doctoral program in information processing. This program might be an extension of the first year graduate school of science information or a school of library science. Its faculty should be selected from among the most distinguished educators and recognized professionals in this area. The doctoral candidates should have demonstrated a comprehensive knowledge of the cycle of information.

The faculty and researchers should concentrate effort on identifying the information requirements of scientists; devising principles of organizing and classifying knowledge; devising information systems, both manual and mechanical; analyzing the components of the cycle of information; and analyzing the operation of information producing and consuming institutions.

c. We also recommend the growth of information centers at universities and the acceptance of doctoral programs in the literature of a science within a graduate science department or engineering school. Possibly, this acceptance would mean permission to present a dissertation on a topic relevant to the science and to information processing.

Opportunities should exist for joint research projects bringing together faculty, students and resources from several disciplines, and the school of information processing. Support for these programs would have to originate from the same sources that contribute to the one year program.

5. Community Colleges

Community colleges should explore the needs of industry for technicians in a science information center and offer appropriate curriculums. These curriculums should consider areas of information work that technicians could perform more efficiently and economically than professionals (e.g. certain basic library routines, machine searching, knowledge of elated communication and equipment, routine indexing and coding tasks, graphics and publication).

6. Professional Organizations

a. An appropriate public or professional organization should study and devise a well-coordinated program of courses, seminars, research groups, and short-term institutes for training people already on the job or about to enter the profession. This program should offer a variety of courses appropriate for technicians, junior scientists, engineers, librarians, literature scientists, and administrative personnel. Such a program should seek the cooperation of scientific societies, industry, library organizations, government, and universities. The aim of the program would be to encourage the use of existing facilities and the development of new training enterprises.

b. The following list describes those organizations able to gain acceptance for the profession and support for education, training, and recruiting of science information personnel. The recommendations in this list are based on interviews and correspondence with officers and members of the organizations and with leaders in science information.

MANNER OF SUPPORT

1R = Financing research
1S = Financing scholarships, fellowships, grants
1O = Financing education and/or training
2 = Engaging in or fostering research
3 = Engaging in or fostering recruiting
4 = Publicizing and gaining acceptance for the profession
5 = Providing coordination for the education, training and recruiting of science information personnel

ORGANIZATION	Manner of Support for Science Information Personnel							
	1R	1S	10	2	3	4	5	
American Association for the Advancement of Science (AAAS)						x	x	
American Chemical Society				x	x	x	x	
American Council of Learned Societies							x	
American Documentation Institute				x	x	x	x	
American Institute of Biological Sciences				x	x	x	x	
American Institute of Physics				x	x	x	x	
American Library Association				x	x	x		
Association of American Library Schools				x		x		
Congress of the U. S.	x	x	x					
Council on Library Resources	x		x					
Deans of Science and Engineering Faculties				x	x	x		
F. I. D. (International Federation for Documentation)				x		x	x	
Foundations, e.g. Ford, Rockefeller, etc.	x	x	x					
Leaders of major industrial firms		x	x			x		
Library of Congress				x	x			
The Modern Language Association	x				x			
National Academy of Sciences - National Research Council						x	x	
National Association of Manufacturers		x				x		
National Science Foundation	x	x	x	x		x	x	
Other scientific and engineering societies				x	x	x	x	
Science Advisor to the President						x		
Science Information Council of the NSF							x	
Special Libraries Association				x	x	x	x	
Trade and commercial associations	x	x	x					
UNESCO	x			x		x	x	
U.S. Congress. Senate. Government Operations Committee				x				
U.S. Government agencies engaged in S.I. activities (ASTIA, OTS, Dept. of Defense, Interior, Agriculture)	x			x	x	x		
U.S. Office of Education		x	x		x			
University Presidents				x	x	x		
Vocational guidance organizations					x	x		

c. No need is greater than for a permanent professional organization that would join the interests of information users, the processors, the educators, the organizations listed above, and the public. A distinguished advisory group drawn from among industrial, governmental, and academic management, working scientists, educators, and information specialists would provide a forum for the exchange of views on the problems of information. This advisory group could draw on the combined talents, resources, and advice of those professional organizations which until now have been intimately concerned with these problems.

The policy and operational tasks of this secretariat might include:

(1.) Developing mechanisms leading to the establishment of

  (a.) A new one-year graduate school for science information specialists

  (b.) Formal Ph.D. programs in systems development and literature science

(2.) Encouraging, organizing, publicizing, and evaluating education and training programs in librarianship and information

(3.) Recommending and sponsoring a recruiting program

(4.) Setting up job classifications and standards for science information specialists

(5.) Carrying forward public and professional relations leading to the identity, definition, and acceptance of the profession of science information.

The initial impetus for such an organization might appropriately come from the Office of Science Information of the National Science Foundation, The American Council of Learned Societies, The National Academy of Sciences, or other national body embracing public and professional interests.

PREDICTIONS

On the basis of the foregoing analysis, one may reasonably expect:

1. Recognition of a more systematic and integrated approach to the organization of science information;

2. Recognition of the science information specialist as a full-fledged professional;

3. An increasingly unified body of knowledge to constitute the core of the education, training, and professional skill of the science information specialist;

4. An increase in the number of specialists going into information work directly and not by transfer from another discipline or aspect of a discipline;

5. Well-supported and organized research, experimentation, and development into the nature of the scientific research process, the information requirements of scientists, the nature of technical literature sources, the traditional manual and mechanical information systems and devices, and the organization and dynamics of information facilities.

6. The advancement of science information specialists to high administrative positions in government, industry, and education.

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v. Extract from the Proceedings of the Symposium on Technical Information Personnel, New York City, April 28-29, 1960, pp. 330f. 95

vi. Extract from a paper of P.R. de Tonnancour, The Education, Training, and Recruiting of Technical Information Personnel 97

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APPENDIX i

CONTRIBUTORS TO TECHNICAL AND SCIENCE INFORMATION PERSONNEL SURVEY

INDUSTRIES

Aircraft

Boeing Airplane Company, Headquarters Offices
Professional Personnel Administrator

Douglas Aircraft Company, Inc., General Office
Staff Assistant to Senior Vice President-Engineering

Lockheed Aircraft Corporation, California Division
Manager, Training Department

The Martin Company
Chief, Libraries

Automotive

Aeronutronic
(A Division of Ford Motor Company)
Division Librarian

Chrysler Corporation
Supervisor, Management Education

Ford Motor Company
Vice President-Engineering and Research

General Motors Institute Library, General Motors
Research Laboratories
Librarian

Chemicals

Allied Chemical, Plastics and Coal Chemicals Division
Information Services

Aluminum Company of America
ALCOA Research Laboratories
Director of Research

American Cyanamid Company, Stamford Research Laboratories
Administrative Director, Central Research Division
Librarian
Technical Information Services

Baker (J.T.) Chemical Company, Technical Department
Director, Technical Information
Editor, Chemist-Analyst

The Carborundum Company, Research and Development Division
Librarian

Celanese Chemical Company
Research and Development Department

Clevite Ordnance
Librarian

The Dow Chemical Company, Western Division
Librarian
Technical Information Services

Dow Corning Corporation

Du Pont (E.I.) de Nemours and Company, Organic Chemicals Department, Research Division, Jackson Laboratory
Librarian

  Explosives Department, Savannah River Laboratory
  Pigments Department, Newark
  Research Department-Experimental Station
  Technical Information Service
  Color Research Library

General Aniline and Film Corporation, Dyestuff and Chemical Division
Librarian

  Ansco
  Research Librarian

Great Lakes Carbon Corporation
Executive Offices

International Minerals and Chemical Corporation
Librarian

Monsanto Chemical Company, Organic Chemicals Division
Technical Editor, Research Department

  Plastics Division
  Librarian

Nopco Chemical Company
Librarian

Chemicals cont'd

Rohm & Haas Company, Research Laboratories
Supervisor of Technical Information

Union Carbide International Company
Division of Union Carbide Company
Linde Company, Tonawanda Laboratories
Market Research Manager
Market Development Department
Technical Librarian

Union Carbide Nuclear Company
Oak Ridge National Laboratory
Chief Librarian

Vitro Laboratories
Silver Spring Laboratories
Librarian

Wyandotte Chemicals Corporation, Patent Department
Patent Counsel

Electronics

Bell Telephone Laboratories, Inc.
Technical Information Libraries
Manager

Burroughs Corporation, ElectroData Division
Librarian

Eastman Kodak Company
Research Laboratories

General Dynamics Corporation
Director of Personnel Development

Convair Division
Chief Librarian

General Electric Company, Research Laboratory
Analyst-Operations

Hanford Laboratories Operation
Supervisor, Reference and Publication

Metallurgical Products Department
Librarian

Goodyear Atomic Corporation
Superintendent, Information and Records

International Business Machines, General Products Division, Product Development Laboratory
Manager, Engineering Communications

Electronics cont'd

International Telephone and Telegraph Corporation
Manager Personnel Development

Micro Switch, Division of Minneapolis-Honeywell Regulator Company
Assistant Chief Engineer

Radio Corporation of America, David Sarnoff Research Center
Vice President, Research and Engineering

Semiconductor and Materials Division
Librarian

RCA Victor Television Division
Librarian RCA Cherry Hill Library

Western Electric Company
Librarian

Westinghouse Electric Corporation, Atomic Power Department
Acting Librarian
Executive Assistant to Vice President-Engineering

Manufacturers

Allis-Chalmers Manufacturing Company, Office President in Charge of Research
President

American Can Company
Vice President

American Machine and Foundry Company, Research and Development Division
Manager, Technical Services Department

Armstrong Cork Company
Librarian

The Bendix Corporation, Bendix Products Division
Librarian

Caterpillar Tractor Company
Supervisor, Technical and Professional Employment

Emhart Manufacturing Company
Librarian

General Foods Corporation, Research Center
Associate Director, Technical Services

The Goodyear Tire and Rubber Company, Research Division
Research Librarian

Manufacturers cont'd

International Harvester Company, Executive Offices
Assistant to Vice President of Engineering

Koppers Company, Inc., Research Department
Manager, Technical Information Group

Owens-Illinois, Technical Center - Research Library
Librarian

Polaroid Corporation
Director of Libraries

The Proctor and Gamble Company, Technical Center
Manager, Technical Information Service

Reynolds (R.J.) Tobacco Company
Director, Research Information

Texas Instruments, Inc., Central Research and Engineering
Technical Intelligence Center

Petroleum

Arabian American Oil Company, Personnel and Administrative Services Department
Manager

The Atlantic Refining Company, Inc., Research and Development Department, Administrative Division
Librarian

California Research Corporation, a Standard Oil Company of California Subsidiary; Richmond Laboratory
Vice President and General Manager

Esso Research Laboratories, Esso Standard, Division of Humble Oil and Refining Company
Librarian

Ethyl Corporation, Research and Development Department
Superintendent, Information Services

Jersey Production Research Company, Technical Information
Technical Information Office

The Ohio Oil Company, General Services Department
Librarian

Phillips Petroleum Company, Research and Development
Manager, Research and Development

Richfield Oil Corporation, Refining Division
Chemist-Librarian

Petroleum cont'd

Shell Oil Company; Shell Development Company
Research Director, Wood River Research Laboratory
Chief Librarian

Socony Mobil Oil Company, Inc., Research Department
Head, Technical Information Services

Standard Oil Company of California, California Research Corporation, La Habra Laboratory
Librarian

Standard Oil Company of Indiana, Research and Development Department, Whiting Research Laboratory
Senior Research Associate

Standard Oil Company of New Jersey
Librarian

Standard-Vacuum Oil Company

Texaco, Inc., Research and Technical Department

Pharmaceuticals

Abbott Laboratories
Librarian

Burroughs Wellcome & Company, Wellcome Research Laboratories
Librarian

Parke, Davis & Company, Research Laboratories
Head of Research Libraries

Pfizer (Charles) and Company, Inc.
Director of Research Libraries

Schering Corporation
Librarian

Searle (G.D.) and Company
Director in charge of Information and Data Center

Smith Kline & French Laboratories, Science Information Department
Research and Development Division

The Squibb Institute for Medical Research
Librarian

Sterling Drug, Inc., Sterling-Winthrop Research Institute
Librarian

Publishers

McGraw-Hill Publishing Company, Inc., Library
Chairman of the Board
Chief Librarian

Steel

Acme Steel Company
Director, Technical Library

American Smelting & Refining Company, Central Research Laboratories
Librarian

Armco Steel Corporation, General Offices
Assistant to Vice President-Research and Technology
Librarian

Jones & Laughlin Steel Corporation, Graham Research Laboratory
Personnel Administrator, Research and Development
Staff Assistant to Vice President-Research and Development

United States Steel Corporation, Personnel Services Department
Director of Employment

RESEARCH CENTERS

Abstracting Services

The Chemical Abstracts Service, Ohio State University
Director and Editor

The Institute of Paper Chemistry
Librarian

National Federation of Science Abstracting and Indexing Services
Executive Secretary

Documentation Centers

American Institute of Biological Sciences
Executive Director

American Institute of Physics
Director

Documentation, Inc.
President

Foreign Sources

Centre National De La Recherche Scientifique
Centre De Documentation (Paris, France)
Direction Et Secretariat

Federation Internationale des Traducteurs (F.I.T.)
Secretariat-Holland
Secretary-Treasurer, New York Branch

G Melin - Institut, Frankfurt/Main
Director

Foreign Sources cont'd

The Japan Information Center of Science and Technology
Chief, Investigation Section

Ministere De L'Education Nationale
Direction Des Bibliotheques (France)
Conservateur en chef

South African Council For Scientific & Industrial Research
Head: Information and Special Services Department

Libraries

Bibliographical Center for Research, Public Library,
Rocky Mt. Region, Denver, Colorado
Director

The Chicago Public Library
Librarian

The John Crerar Library
Librarian

The Midwest Inter-Library Center
Director

The New York Public Library
Chief of the Personnel Office

Professional Publications

Scripps Institution of Oceanography, University of California

Committee on Chemical Documentation, ACS Division of
Chemical Literature, American Chemical Society
Chairman, Committee on Chemical Documentation

Mathematical Reviews, American Mathematical Society
Executive Editor, Mathematical Reviews

Professional Societies

American Documentation Institute, Office of the Secretary
Secretary

American Association of Petroleum Geologists, Oklahoma
Headquarters Secretary

American Association of Petroleum Geologists, Denver, Colorado
President

American Association of Textile Chemists & Colorists
Executive Secretary

Professional Societies cont'd

The American Ceramic Society, Inc.
General Secretary

American Chemical Society, Office of Executive Secretary
Executive Secretary

American Geographical Society, Office of the Director
Director

American Institute of Biological Sciences
Executive Director of Publications

American Oil Chemists' Society, Headquarters
Secretary

American Nuclear Society
Executive Secretary

American Physiological Society
Executive Secretary

American Rocket Society, Inc.
Director of Publications

American Society of Civil Engineers
Assistant to the Secretary

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
Technical Secretary

American Society of Ichthyologists and Herpetologists

American Society of Mechanical Engineers
Assistant Secretary

American Society For Metals
ASM Documentation Service Editor

American Society of Naval Engineers, Inc.
Secretary-Treasurer

American Society Of Safety Engineers
Managing Director

Association for Computing Machinery
Executive Secretary

Association of Iron and Steel Engineers
Managing Director

Engineering Societies Library
Director

Professional Societies cont'd

Institute For Advancement Of Medical Communication
Administrative Secretary

National Academy of Sciences, National Research Council
Director, Office of Documentation

National Council of Technical Schools
President

Society of Federal Linguists
President

Special Libraries Association
President
Executive Secretary

Battelle Memorial Institute
Chief, Information Management Division

Research Corporations

Ramo-Wooldridge, A Division of Thompson Ramo Wooldridge, Inc.
Manager, Synthetic Intelligence Department

The Rand Corporation
Assistant Librarian

Science Communication, Inc.
President

Universities

University of California, General Library
Assistant Librarian

University of California, Los Alamos Scientific Laboratory
Assistant Head Librarian

California Institute of Technology
Director of Libraries

Carnegie Institute of Technology, The Library
Librarian

University of Chicago, Office of the Director
Director

University of Cincinnati, Office of University Librarian
University Librarian

University of Colorado Libraries
Director

Columbia University, Faculty of Medicine
Professor of Library Service and Head Librarian

Universities cont'd

Duke University
University Librarian

Georgia Institute of Technology, Price Gilbert Library
Director of Libraries

Iowa State University of Science and Technology
Director

University of Kansas, Office of The Director of Libraries
Assistant Director

University of Kentucky, Margaret I. King Library
Director of Libraries

Massachusetts Institute of Technology, Lincoln Laboratory
Director of Library Services

University of Michigan, University Library
Assistant Director

University of Minnesota, University Library
Supervisor, Departmental Libraries

University of North Carolina Library
University Librarian

Ohio State University Libraries, Director of Libraries
Personnel Librarian

University of Oklahoma
Director of Libraries

University of Oregon
University Librarian

University of Pittsburgh, University Library
University Librarian

Princeton University, The Library
Librarian

Purdue University
Director of Libraries

University of Texas, Office of the Librarian
Librarian

University of Virginia, Alderman Library
Office of the Librarian

University of Washington, Library
Director of Libraries

Government Agencies

Central Intelligence Agency, Office of the Assistant Director for Central Reference
Deputy Assistant Director

Librarian of Congress, The Library of Congress

The Library of Congress, Reference Department, Science and Technology Division
Head, Reference Section, Science and Technology Division

National Aeronautics & Space Administration, Flight Research Center, Edwards, Cal. Headquarters, Wash.
Personnel Officer

National Aeronautics & Space Administration, Headquarters, Wash.
Assistant Director for Technical Information

National Aeronautics & Space Administration, Langley Research Center
Placement Officer

National Science Foundation, Office of Science Information Service
Head

Tennessee Valley Authority
Chief, Employment Branch, Division of Personnel

U.S. Department of Agriculture, Library
Director

U.S. Army Ordnance Missile Command, Army Rocket and Guided Missile Agency
Chief, Technical Library

U.S. Department of Commerce, National Bureau of Standards, Office of the Secretary
Librarian

U.S. Department of Commerce, Patent Office
Chief Librarian
Acting Associate Director, Research and Development

U.S. Department of Commerce, Office of Technical Services
Chief, Technical Information Division

U.S. Department of Defense Headquarters, Armed Services Technical Information Agency - Air Research and Development Command
Colonel, USAF, Commander and Director

Air Force Research Division, Air Research and Development Command
Chief, Technical Information Division

Air University Library, Maxwell Air Force Base, Alabama
Director

Government Agencies cont'd

U.S. Department of Defense, Office of the Director of
Defense Research and Engineering
Director, Office of Review and Services

U.S. Department of Health, Education, & Welfare, Public
Health Service
Executive Editor, Public Health Reports
Librarian, National Institutes of Health

U.S. Department of Interior, Bureau of Mines
Chief, San Francisco Petroleum Research Laboratory
Librarian

U.S. Department of the Navy, Office of Naval Research
Training Specialist by direction of Chief of Naval Research

U.S. Government Printing Office, Division of Public Documents
Superintendent of Documents

U.S. Information Agency
Chief, Employment Branch

U.S. Naval Academy (Annapolis), Library
Professor, Librarian

U.S. Naval Civil Engineering Laboratory, Port Hueneme, Cal.
Librarian

U.S. Naval Postgraduate School, The Library
Director of Libraries

U.S. Navy Underwater Sound Laboratory, Fort Trumbull,
New London, Conn.
Chief Librarian

Norfolk Naval Shipyard, Technical Library
Technical Librarian

LIBRARY SCHOOLS

University of Chicago, Office of the Dean
The Dean

Columbia University, Office of the Dean
The Dean

Drexel Institute of Technology
Graduate School of Library Science
The Dean

Florida State University, Library School
The Dean

Library Schools cont'd

University of Illinois, Graduate School of Library Science
Director

Indiana University, Division of Library Science
Director

Louisiana State University, Library School
Director

Pratt Institute Library School
The Dean

Rutgers University, Graduate School of Library Service
The Dean

University of Southern California
School of Library Science
The Dean

Syracuse University School of Library Science
Associate Professor of Library Science

APPENDIX ii

Membership of The Symposium on Technical Information Personnel sponsored by the Foreign Language Program Technical Information Project of The Modern Language Association Of America, New York City, April 28 - 29, 1960.

Dr. Burton W. Adkinson (General Chairman)
Head, Office of Science Information Service
National Science Foundation

Mr. Leonard Cohan, Director
Foreign Language Program Technical Information Project
The Modern Language Association of America

Mr. Kenneth Craven, Director
Foreign Language Program Technical Information Project
The Modern Language Association of America

Mr. P. R. deTonnancour
Chief Librarian
Convair
Division of General Dynamics Corporation

Dr. Edmond L. d'Ouville, Director
Technical Information and Liaison
Research and Development Department
Standard Oil Company (Indiana)

Mr. Thomas P. Fleming
Professor of Library Service and Head Librarian
Faculty of Medicine
Columbia University

Mr. Herman H. Henkle, Librarian
The John Crerar Library

Dr. Karl F. Heumann, Director
Office of Documentation
National Academy of Sciences
National Research Council

Dr. William N. Locke
Director of Libraries
Massachusetts Institute of Technology

Mr. Henry C. Longnecker
Science Information Department
Research and Development Division
Smith Kline & French Laboratories

Mr. W. Kenneth Lowry, Manager
Technical Information Libraries
Bell Telephone Laboratories, Inc.

Dr. Ralph R. Shaw, Dean
Graduate School of Library Service
Rutgers University

Dr. Jesse H. Shera, Dean
School of Library Science
Western Reserve University

Mr. Ernest F. Spitzer
Director
Research Libraries
Charles Pfizer and Company, Inc.

Dr. Mortimer Taube, President
Documentation, Inc.

APPENDIX iii

ELEMENTS OF SCIENCE INFORMATION WORK

1. Administering: The management of an information center; the coordination of the information elements into an integrated system anticipating user requirements and planning appropriate solutions; liaison with line and staff departments served by the information center.

2. Locating Materials: The process of identifying, finding, and obtaining copies of information materials not in the information center.

3. Selecting Materials: Planning the nature, variety, and depth of materials to be included in the center and choosing the specific items to be acquired.

4. Acquiring Materials: The implementation of the selection process by the technical operations of purchasing, exchanging, and gifts.

5. Descriptive Cataloguing: Identifying and characterizing a unit of information by bibliographic criteria and organizing it in a methodical arrangement.

6. Subject Analyzing, including Classifying/Subject Headings, and Indexing: Identifying and characterizing a unit of information on the basis of its intellectual content and organizing it in a methodical subject arrangement.

7. Abstracting and/or Annotating: The summarizing of a unit of publication so as to present in concise form the needed bibliographic and/or subject information.

8. Performing Reference Work: Meeting the needs of users by joining a knowledge of the bibliographic and subject resources of the information center to an analysis of the specific information requirement.

9. Literature Searching-Bibliography: Reviewing, locating, identifying and compiling units of information related by subject, bibliographic and/or user criteria.

10. Transmitting and Copying: The conveying and communicating of units of information by manual, electronic, mechanical, and other means.

11. Translating: The converting of a unit of information from one language or other symbolic form into another, with a minimum of subject distortion.

12. Converting into Machinable Form: Translating a unit of information into a symbolic form so as to be suitable for storage, identification and retrieval by mechanical or electronic instrumentation.

13. Developing of Information Systems: Devising integrated schemes for coordinating all required elements of the information cycle in order to make available all pertinent materials to all potential users in the most usable form with the least distortion of subject content and in the shortest time.

14. Investigating of Machine Applications: Developing mechanical and electronic instrumentation to perform specific information functions in an integrated information system.

15. Information Interpreting: Evaluating and elucidating the significance, pertinence, and relevance of specific units of information on the basis of detailed analysis and deep subject competence.

16. Researching With Information: The solving of research problems without recourse to experimentation by gathering, analyzing, and inter-relating information from a combination of sources.

17. Information Scouting: The active locating, gathering, and screening of new unrecorded, not yet recorded, and newly recorded data and information from special sources such as personal contact, conferences, meetings, government agencies, laboratories, clinics, interviews, etc.

APPENDIX iv

EXTRACTS FROM TYPICAL SCIENCE INFORMATION JOB DESCRIPTIONS

SCIENCE ACQUISITIONS SPECIALIST
Library Of Congress
Reference Department, Science and Technology Division
Reference Section

1. Assists in planning and directing the Division's program for the acquisition of scientific and technical materials for the library's collections in science and technology.

2. In consultation with the Division Chief and the Head of the Reference Section, recommends to the Processing Department the acquisition of scientific and technical material to fill existing gaps in the Library's collections.

3. Keeps thoroughly informed of the collections in the science and technology of other libraries in this country; maintains necessary liaison with libraries in the adjacent area, to avail himself of knowledge of their resources.

4. Keeps informed continuously of publications and developments in the field of scientific and technical research in this and other countries involving frequent contact with originators of literature in science and technology. Recommends to the Processing Department through the channels for acquisition of new research material, the acquisition of new scientific and technical material, and investigates the problem involved in arranging for initial and continuing receipt of such material by the Library of Congress. Reviews specific requests which come to the Division for either published or unpublished literature in the field of sciences and technology, locating materials in the Library's collections or from outside sources, or recommending sources for acquisition when such action seems desirable.

5. Maintains liaison with the Processing Department, The Coordinator for the Organization and Development of the Collections, and recommending officers of the Reference Department and discusses with them problems of mutual interest to the Division and to the Library concerning the acquisition of scientific and technical material.

6. Recommends the acquisition and assignment of materials for the Reference collections of the Science and Technology Division as well as those of the Division's reading room.

7. Directs the preparation periodically of current listings of acquisitions and information sources of particular interest in various scientific subject fields for general distribution; is responsible for the editing of copy for the printer, and the accuracy of typed and printed material in its preliminary and final form. Prepares single, or multiple listings by title, author, country, institution, or subject.

8. The position requires the ability to plan and organize an intensive acquisition program in scientific and technical materials; the application of thorough scientific training and knowledge in evaluating scientific and technical source materials as well as a knowledge of acquisition procedures and related fiscal problems. In addition, the work necessitates a working knowledge of two or more modern foreign languages, a good knowledge of the Federal library system, and demonstrated ability to keep pace with new developments in science, technology and documentation.

SCIENCE BIBLIOGRAPHER
Library Of Congress
Reference Department, Science and Technology Division
Reference Section

Under the general direction of the Division Chief, is responsible for the formulation and planning of the Science Division bibliographic program, comprising card bibliographies of important reference materials, specialized demand bibliographies of unusual current interest, and full-scale bibliographies intended for publication and major distribution, and for the compilation and editing of such bibliographies, exercising initiative and independent judgment as to the selection of materials and to the preparation of critical abstracts and annotations of included materials.

1. Recommends the preparation of bibliographies in certain fields, including the updating of existing bibliographies. Makes recommendations on the scope and content and plans working procedures, submitting samples of data and printed cards for approval or for discussion of form, style, and content. Prepares time, cost, and size estimates.

2. Consults the collections of the Library of Congress and other libraries in the District of Columbia to locate all possible sources of bibliographic information for use in compiling assigned bibliographies--booklists, specialized card catalogs, review publications, indexes and subject bibliographies. Initiates searches for material not located in the District of Columbia, by correspondence if necessary, occasionally traveling to other cities to examine such materials.

3. Selects specific publications to be included on the basis of subject matter and level of technical treatment, (for example, original research, reviews, abstracts, news notes, text books, etc.) Prepares preliminary data cards, giving such information as title, author or issuing agency, publisher, country and language of publication, dates, subject classification and cross references. Lists other aspects of interest such as special features, nature of contents and frequency of serial publications. In special cases, discusses with potential users the need for descriptive notes and critical evaluation of entries.

4. Recommends arrangement of entries in the bibliography and assigns to each publication one or more subject classifications. Develops and recommends classification system to be used, applying a knowledge of Library of Congress, Dewey Decimal and comparable classification system in specific fields of science and technology.

5. Develops and recommends editorial policies governing publication of bibliographies, such as overall format, pagination, and nature and extent of introductory material and indexes. Recommends type of reproduction, devising techniques for economical reproduction of special lists. Edits copy for printer or for typing on cards or on mats. Proofreads, and is responsible for the accuracy of typed and printed material in its preliminary and final forms. Prepares single or multiple indexes by title, author, country, institution or subject. Maintains contact with the Card Division, Photoduplication Service and Government Printing Office in handling editorial and administrative matters relating to processing and publishing of bibliographies.

6. Maintains continuing contacts with local reference libraries, professional organizations and contracting agencies, if any, for the purpose of locating sources of bibliographic data, avoiding duplication of bibliographic effort, and exchanging information on research activities in the fields of science and technology. Maintains awareness of report literature developments and of related documentation and document reproduction activities.

LIBRARIAN
U.S. Office of Technical Services
Foreign Science Reference Unit
Identification Section
Reference Branch
Technical Information Division

The incumbent of this position serves as reference librarian and is responsible for conducting comprehensive research for unidentified items, analyzing, evaluating and processing problem requests, status inquiries, resubmitted and priority requests in connection with English translations of foreign scientific materials.

1. Receives, **analyzes** and conducts comprehensive research on requests for English translations of foreign scientific and technical reports, monographs and periodicals received from scientists, engineers, librarians and other persons engaged in basic and applied research.

2. Conducts reference searches on those requests for translations which are not identified by TID translation number or requests which are otherwise stated in general and indefinite terms. Analyzes such unidentified requests and conducts a search of the Technical Information Division's catalogs and other possible sources to determine translation number, originating agency order number, availability, price, and other bibliographic data.

3. When all possible searching efforts have been accomplished and the item requested is still unidentified, decides on appropriate disposition; namely, referral to acquisition request further identifying information, or referral to specific agency originating the translation.

4. Initiates and composes correspondence to notify requester of items which must be acquired, additional identifying information required, referral to other agencies of items not handled by OTS or any other information pertaining to request.

5. Thorough knowledge of Federal agencies and commercial organizations engaged in translation services, contacts potential sources of data for the acquisition of translations in response to specific requests. Acquires information for ordering material in various fields such as biology, chemistry, engineering, physics, medicine, metallurgy, electronics, mathematics, etc., for the purpose of answering individual inquiries and obtaining material which will have broad reference value to the collection.

LIBRARIAN (CATALOGING)
U.S. Office of Technical Services
Descriptive Cataloger and Searcher, Processing Branch
Descriptive Cataloging Section, Technical Information Division

Under the general supervision of a Reviser of Descriptive Cataloging and Searching:

1. Searches in the catalogs of the Division to identify scientific and technical reports and translations and to establish the form of previous catalog records (identification of these reports and translations is particularly difficult because of the meager and inconsistent bibliographical data contained in them).

2. Adapts catalog cards from other sources to conform to Technical Information Division standards.

3. Prepares descriptive entries for these reports, selecting the most specific distinctive entry for the main entry which contains the following elements in order given:

   a. Name of contractor or Government agency performing the research, or the personal author;

   b. Report title;

   c. Personal author;

   d. Project title;

   e. Date of publication;

   f. Collation;

   g. Additional significant identification numbers and symbols;

   h. Availability and price of material;

   i. Drop notes establishing the original source of translations; assigns added entries for personal authors, series notes, contract numbers, and additional corporate authors; prepares authority cards for new corporate authors, series, contract, and periodicals established.

4. Files temporary catalog cards in the Division catalogs by (1) corporate or personal author, (2) series and periodical references.

LIBRARIAN (REFERENCE)

U.S. Office of Technical Services
Reference Branch, Bibliography and Reader Service Section
Technical Information Division

The incumbent of this position serves as Senior Reference Librarian and is responsible for reviewing the work of bibliographers and reference librarians engaged in preparing bibliographies and literature surveys in the field of science and technology.

1. Assists the reference librarians and bibliographers in interpreting requests for bibliographies and literature searches, giving guidance in subject headings to be searched, interpreting the scope or time covered by question, determining the pertinence of individual references and selected material.

2. Without review as to content, prepares the most difficult bibliographies for industry and research organizations including those highly selective from a subject point of view; those made difficult by the newness of the area of interest and lack of development therein; those prepared for a specific person or use urgent in time or application, or a combination of these characteristics.

Performs the most difficult reference work in response to written or telephone requests. Interviews scientists, engineers, and technical librarians visiting the Section to perform research, analyses questions and selects material pertinent to the project on which they are working. By keeping abreast of new developments in scientific and technical fields, is able to furnish information not already received and to direct requesters to additional sources not available to the Office of Technical Services.

3. Reviews the work of reference librarians and bibliographers and trains new personnel in reference and bibliographic techniques.

4. Participates with the Chief of the Section in the development of new bibliographical techniques and in scheduling and formulating procedures to control the bibliography workload.

5. Translates Russian and other Slavic correspondence for the Office of Technical Services; for cataloging purposes, reviews, interprets, and transliterates questionable names of authors and titles of reports to see that they are correct and conform to accepted transliteration procedures; assists in establishing references for the reports from abbreviated sources and if translations are not understandable or ambiguous, checks on their accuracy when original document is available.

ANALYST (SCIENCE AND TECHNOLOGY)
Library Of Congress
Reference Department
Science and Technology Division

This position is one of several assigned to one or more special projects of the Science and Technology Division. The purpose of these large-scale projects is the exploitation of world-wide scientific and technical literature, both classified and unclassified, and the evaluation of this material for selection for bibliographies sponsored by government agencies or industrial organizations.

1. Analyzes and evaluates current and retrospective domestic and foreign (often in foreign language) scientific and technical literature in one or more fields of science. (Includes literature in libraries in the Washington area and that he requests from foreign sources.) Determines the relevance of such literature to the purpose of the bibliographic project being undertaken. Writes abstracts, indicating any items which reflect significant advances. Prepares indexes. Assembles his findings in bibliographic form for publication with other portions of the bibliography.

2. Maintains, as assigned, a continuing surveillance over information on specific aspects of a particular field of science of priority interest to the sponsoring agency.

3. Provides reference service in his subject specialty to the sponsoring agency and to Library staff members.

4. Reviews and evaluates bibliographies prepared by other organizations in the program, and, if required, prepares a detailed report for his supervisor.

TECHNICAL REPORTS ANALYST
U.S. Office of Technical Services
Subject Analysis Section
Processing Branch
Technical Information Division

1. Assigns subject headings to scientific and technical documents and translations in the fields of physics, nuclear physics, electronics, mathematics, chemistry, geophysics, fluid dynamics, mechanics, materials, meteorology, psychology, and the biological and medical sciences.

2. In the field or fields of his special competence subject catalogs the most difficult reports. Performs the necessary research in establishing new headings in these fields with full responsibility for the correctness of the scientific information included in the new headings, and applied in established headings. Prepares authority cards for new combinations of established headings and subdivision. Is responsible for the review of that portion of the subject heading list pertaining to his subject specialty and scheduling and recommending changes thereto.

3. Upon assignment by the senior subject cataloger, reviews the subject cataloging in a given field. When the workload demands, and during the absence of the senior subject cataloger, assists in the review and revision of the subject cataloging performed by the Section. May assist in the indoctrination and training of subject catalogers at the trainee and intermediate levels.

4. Advises members of Reference Section staff on probable location of difficult material.

TECHNICAL REPORTS ANALYST
U.S. Office of Technical Services
Subject Analysis Section
Processing Branch
Technical Information Division

The incumbent of this position serves as Senior Abstractor and is responsible for reviewing the work of subject specialists engaged in the abstracting activities of the Division.

1. Is responsible for the technical accuracy of the abstracts, prepared in the Section, containing the following information:

   a. Purpose, nature, and scope of the investigation;

   b. The nature of the significant results which were obtained, with samples of the results if they may be stated readily;

   c. The methods used in making the investigations;

   d. Conclusions drawn from the experimental work and their application to one or more fields of science;

  e. Correlation with previously performed investigations either published in scientific literature or reported in the Technical Information Division collections.
  Edits the abstracts for grammatical structure, punctuation, spelling, technical nomenclature, form, clarity, conciseness, and adherence to editorial standards.

2. Modified and edits abstracts prepared by contractors, authors, or translators when such abstracts do not meet criteria established by the Office of Technical Services.

3. Abstracts most difficult material or that having top priority.

4. Interprets to **abstractors** under his guidance, instructions concerning new or changed policies and procedures to be followed in performing the work and assists them in applying these to specific reports or translations.

5. Contributes to the compilation of terminology and scientific reference aids.

TECHNICAL REPORTS ANALYST

U.S. Office of Technical Services
Subject Analysis Section
Processing Branch
Technical Information Division

1. Assigns subject headings to scientific and technical reports and translations in a given field in which the incumbent has special training.

2. Assists in the development of the Division's list of subject headings by recommending the establishment of new headings. Performs the necessary research for establishing these headings.

The assigning of subject headings to technical and scientific reports involves the checking of the subject catalogs, based on the subject headings of the Armed Services Technical Information Agency, to establish the subject heading for the material to be cataloged. Using the abstract of the material which has been previously prepared in another section, the incumbent searches the subject catalog for similar material previously cataloged and sometimes checks with the Bibliography Section to establish the correct subject heading. It is also necessary to refer to the authority file (a list of subject headings) to insure that the material is being placed in the correct heading.

If there is no established subject heading under which the material can be properly placed, it is necessary to do research prior to the establishment of new headings. This research entails reading and searching through articles, manuals, and basic texts in the field being catalogued to determine the applicable and current terminology to use as the new subject heading. When the appropriate term has been developed, and reviewed by the supervisor, the incumbent then adds it as a subject heading to the authority file and assigns the material under this subject heading.

Each of the subject cataloguers has a background in a specific scientific field and is responsible for assigning headings to materials in this field. A thorough knowledge and understanding of the technical field covered by the material being assigned subject headings is necessary to assure that the material is assigned correctly and efficiently. By knowing and understanding the material, the incumbent is able to relate and place it in its proper heading, and in the case of establishing new headings is able to conduct the research; a process which would be time consuming and prone to error were he not educated in the field in which he is assigning headings. For example: In the case of material on electricity, it might be necessary to distinguish between alternate and direct current from only diagrams. The type of current would make a difference in the subject heading of the material. Another example would be in the case of motors. The dictionary definition might not give the proper meaning and from the description and diagram the incumbent would rely on his knowledge of motors and give the proper heading. In the case of laboratory animals which could be placed under medical or physiological or zoological headings, the incumbent must know something about each of these fields and the animals used in each.

PROJECT SUPERVISOR (Science and Technology)
Library Of Congress
Reference Department
Science and Technology Division

Serves as one of several project supervisors (Science and Technology) in the Science and Technology Division with over-all project responsibility to prepare continuing literature surveys in one or more fields of science and technology. The surveys or projects are sponsored by agencies of the government or industrial organizations and each incumbent carries over-all responsibility for a project. Examples of kinds of projects are Aerospace Medicine, Industrial Applications of Radioisotopes, Cold Regions, etc.

He is responsible for planning the survey and the bibliography; exploring and analyzing the literature; developing, compiling, and maintaining a selective bibliography with abstracts (and indexes) of foreign or domestic literature, classified or non-classified, in one or more fields of science and technology.

1. With over-all responsibility for a project, plans and schedules the bibliographic operation, making preliminary surveys and estimates of number and grades of personnel and length of time required for the operation.

2. Is responsible for the preparation of subject and author indexes,

subject classifications, and abstracts or annotations. May have to indicate technical level of the item and its uniqueness or novelty. Individual bibliographic projects cover such areas as, in the industrial radioisotope applications project, radioisotopes used, techniques of application, industry, process material, etc. (Literature surveyed includes that in other libraries in the Washington area and that he requests from foreign sources.) Responsible for completion on schedule.

3. Is responsible for arranging with the Library or GPO (through the Information Office) for the printing of the bibliography.

4. Serves as main Library point of contact with sponsoring agency on the project, signing correspondence regarding the project, except that on administrative and fiscal matters. Consults with the sponsoring agency on changes, which he suggests or the agency requests, in such areas as subjects and coverage; with ASTIA on the use of ASTIA documents; OTS for translations; other Government agencies, private organizations and Division members on new scientific developments and current research (to insure the use of all available sources of information) and other Library personnel regarding Library policy.

5. Determines that the bibliography meets the sponsoring agency's requirements for subject matter and the Division's standards of quality.

6. Recommends to the Head of the Science Reference Section the acquisition of library materials, particularly in his specialized area.

7. Reports in writing quarterly to Division Chief the status of the bibliography, any substantial changes in estimated time of completion, unusual problems, etc. Also at his discretion, informally advises the Chief of progress.

8. The incumbent must use his specialized scientific Library and bibliographic training and knowledge in planning and making critical literature surveys for selective bibliographies and in providing reference service. He must show judgment and alertness in following new developments in his particular field of science, and use such knowledge in executing his assignment.

SCIENCE RESEARCH SPECIALIST
Library Of Congress
Reference Department, Science and Technology Division
Reference Section

Studies developments in documentation techniques, with particular emphasis on mechanical methods of information storage and retrieval. Evaluates effectiveness of methods and systems in early stages of new developments in documentation techniques. Performs specialized reference services in science and technology in his particular field or fields of science.

1. Keeps informed of developments in the field of documentation, with particular study of mechanical methods for information storage and retrieval; evaluates the effectiveness of methods and systems and in the early stages of new developments in documentation techniques, recommends these techniques which would be worthy of trial or application in the Science and Technology Division. Conducts such trials or applications until these are either rejected or found to be acceptable or advisable.

2. In connection with the foregoing, the incumbent investigates "Coordinate Indexing", "Multi-aspect Systems" and "Faceted Classification" as well as means for implementing such indexing, e.g., edge-punched cards, peek-a-boo techniques, and tabular or numerical forms.

3. The incumbent will also work on the compilation of a "Science and Technology Thesaurus" upon which to base coordinate indexing and other systems.

4. Based on training and experience in physics, electronics, and related specialized areas in science and technology, provides advanced reference service in these areas to the Library's clientele.

5. Directs and reviews the work of lower grade personnel assigned to him for the preparation of the "Science and Technology Thesaurus" and the assignment and entry of index terms under the various classification schemes.

SLAVIC SCIENCE REFERENCE SPECIALIST
Library Of Congress
Reference Department, Science and Technology Division
Reference Section

Serves as the Division's reference specialist in the area of Slavic science and technology.

1. Performs specialized and selective reference service on the more advanced and difficult requests for information in the field of scientific and technical literature of the USSR and other Eastern European countries, such requests originating from Members of Congress, government, industry, scholars, and the general public.

2. In consultation with the Division Chief and the Head of the Reference Section, assists in formulating and planning the Division's reference program with respect to science and technology materials published in the USSR and other Eastern European countries, with the objective of making the Division's reference program as comprehensive as possible in this area and also with the objective of providing the best general as well as the most advanced science reference service possible to render.

3. Prepares reports and executes studies on special problems related to science and technology in the USSR and other Eastern European countries. Prepares correspondence in reply to reference inquiries, and assists readers in locating material of an obscure or specialized nature which requires extensive searching of lesser known sources.

4. Keeps informed of and assesses current developments in science, technology and bibliography in the USSR and other European countries with a view to keeping his reference services and planning functions as contemporary as possible.

5. Also keeps informed of and assesses major current translation activities in the United States and elsewhere involving materials originally published in Russian and other Eastern European languages, and gives advice on questions related thereto.

6. Recommends to the Slavic Science Acquisitions Specialist the acquisition of science and technology materials from the USSR and other Eastern European countries on the basis of gaps in the Library's holdings recognized in the course of reference work. Review of the Library's holdings for the purpose of making recommendations for retaining or discarding such literature based on the over-all reference needs of the Library with special attention to the subject usefulness to American scientists and researchers.

7. Directs the maintenance [illegible] reference collection in science [illegible] the USSR and other Eastern European countries.

8. The incumbent must apply an expert knowledge of available source materials and current literature in the field of science and technology as well as an understanding of research techniques in those fields; he must exercise skill in the application of library regulations and procedures in solving reference problems; he must apply a thorough knowledge of Russian and a number of other Eastern European languages; he must demonstrate judgment and alertness in following new developments in his field and geographic area as well as in examining and evaluating pertinent Library collections.

SCIENCE SPECIALIST (BIOLOGICAL SCIENCES)

Library Of Congress
Reference Department, Science and Technology Division

Under the administrative supervision of the Chief of the Science and Technology Division, with work reviewed only from the standpoint of Library policy, serves as a reference and bibliographic consultant in the Biological Science and related fields, and advises on the acquisitions policy of the Library in these subject areas.

The Science Specialist in the Biological Sciences, Science and Technology Division, serves as consultant to, and prepares analytical and evaluative reports for Members and committees of Congress, government agencies and private researchers; promotes cooperation with domestic and foreign research centers; advises the Division Chief of research and development trends in the Biological Sciences for the latter's consideration in determining program emphasis.

1. Serves as consultant in the Biological Sciences to the Congress, Government agencies, and private researchers requiring specialized assistance.

2. Prepares comprehensive analytical and evaluation reports in the Biological Sciences.

3. Responsible for generating a major portion of his work progress by imaginative and reliable response to requests for information. Thus he establishes confidence in his work which users show by asking additional requests.

4. Analyzes Library resources and proposes analytical and/or evaluative reports and bibliographic studies which would contribute to the programs of the Congress or Government agencies. Also, from information gained through his con-

sulting services and studies, proposes studies which appear useful. Proposes these studies to possible users and participates with them in determining the scope and limits of the studies. He recommends studies to the Division Chief which are outside his area or which he does not have time to conduct.

5. Confers informally with the Division Chief and the Science Specialist in the Physical Sciences on current developments in science. Each contributes what he has learned in his consultations. He and the other Science Specialist advise the Chief as to possible fruitful areas of emphasis for the Division program.

6. Collaborates with the Library administration in the promotion and cultivation of cooperation between the Library and foreign government research centers and institutions interested in the Biological Sciences; represents the Library administration at national and international conferences concerned with Biological Sciences and of significant interest to the Library.

7. Performance of this work requires the use of knowledge gained through extensive training and experience in the Biological Sciences; the exercise of initiative and resourcefulness in exchanging information with scientists on the state of the art and proposing studies of worth in the programs of users and possible users; and ability to gain the confidence of users and develop and maintain avenues for obtaining information on research programs. (The incumbent must have demonstrated leadership and must have achieved recognized standing in his field of specialization.)

APPENDIX V.

EXTRACT FROM THE PROCEEDINGS OF THE SYMPOSIUM ON TECHNICAL
INFORMATION PERSONNEL, NEW YORK CITY, APRIL 28-29, 1960,
pp. 330f.

MR. FLEMING: This is probably the wrong time to bring this point up, but from the very beginning, I have recoiled at the continuous use of the words "technical information." A technical information officer does not seem to be descriptive of the activities.

It seems to me that when you say technical information, you automatically leave out anyone who is concerned with information in other branches of the sciences. For example, no medical information officer would wish to be called a technical information officer.

Therefore, I would suggest that the over-all term should be that of science information officer, rather than technical information officer.

CHAIRMAN SPITZER: Very much so.

MR. FLEMING: We did not call it the National Technical Foundation or anything of that sort in the Government. The word "technical" has a connotation with technician. I should think that what we are talking about are either science information officers or literature scientists.

CHAIRMAN SPITZER: As a matter of fact, I feel so strongly about it that I think that throughout the educating that should be given consideration.

We sort of drift along -- a number of us who are in the technical field are used to it and we do not even hear the meaning of it any more -- but I think that should be changed.

APPENDIX vi.

Extract from a paper of P. R. de Tonnarcour, The Education, Training, and Recruiting of Technical Information Personnel, presented to The Symposium of Technical Information Personnel, New York City, April 28-29, 1960, p. 1.

Over thirty accredited library schools in the United States are in a position to prepare individuals, at least in part, for a career in technical and science information work. A study of the catalogs ofthese schools, together with information gathered in recent surveys, show the following results:

1. What may be called "special library programs" are offered by eight of these schools. Of these programs, one is in chemistry, two are in medicine, and three are in science-technology.
2. Courses identified with special libraries in general are offered by some fifteen other schools.
3. Several other schools have seminars arranged by kinds of libraries, usually including special libraries in a special seminar.

More than two-thirds of the accredited schools had some course, or program of courses, etc., beamed at special librarianship. Required bibliography courses in the literature of science and technology are offered by most, and those that do not require this course at least offer it as an elective. Courses in documentation and science-documentation are offered by 20% of the accredited schools. Two of them offer courses in indexing and abstracting. One school offers courses in machine literature searching, language engineering, and microrecording applications. Several offer bibliographic courses in specialized disciplines (medicine, agriculture, etc.) and one school includes a Center for Documentation and Communication Research.